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WETLAND USE BY WATERBIRDS THAT WINTER IN COASTAL TEXAS

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Wetland use and selection by species of waterbirds (shorebirds, wading birds, gulls, terns, grebes, cormorants, and pelicans) between the Rio Grande and Galveston Bay in coastal Texas were studied during September and November of 1991-92 and during January and March of 1992-93. Based on a stratified (by dominant land use) random sample of 64.75-ha plots, 88 species of waterbirds using the wetlands were observed. Ranks of density and proportion of feeding birds indicated that cormorants and pelicans preferred wetlands with less than 30% vegetation. Gulls, terns, and skimmers preferred certain types of estuarine and lacustrine wetlands with less than 30% vegetation, especially estuarine subtidal rock bottom rubble types. Grebes and rails selectively used palustrine aquatic-bed rooted vascular and unconsolidated bottom mud wetland types. Herons, egrets, and bitterns preferred certain types of lacustrine and estuarine wetlands. Shorebirds used estuarine intertidal wetlands. Waterbird management should focus on 26 of the 82 wetland types that we prioritized in the coastal plains of Texas. Management should focus on protecting, enhancing, or restoring complexes of various wetland types, especially estuarine aquatic-bed and intertidal unconsolidated substrate types.

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WETLAND USE BY WATERBIRDS THAT WINTER IN COASTAL TEXAS

by

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Contents

Tables

Figure

Wetland Use By Waterbirds that Winter In Coastal Texas

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Abstract. Wetland use and selection by species of waterbirds (shorebirds, wading birds, gulls, terns, grebes, cormorants, and pelicans) between the Rio Grande and Galveston Bay in coastal Texas were studied during September and November of 1991-92 and during January and March of 1992-93. Based on a stratified (by dominant land use) random sample of 64.75-ha plots, 88 species of waterbirds using wetlands were observed. Ranks of density and proportion of feeding bird indicated that cormorants and pelicans preferred wetlands with less than 30% vegetation. Gulls, terns, and skimmers preferred certain types of estuarine and lacustrine wetlands with less than 30% vegetation, especially estuarine subtidal rock bottom rubble types. Grebes and rails selectively used palustrine aquatic-bed rooted vascular and unconsolidated bottom mud wetland types. Herons, egrets, and bitterns preferred certain types of lacustrine and estuarine wetlands. Shorebirds used estuarine intertidal wetlands. Waterbird management should focus on 26 of the 82 wetland types that we prioritized in the coastal plains of Texas. Management should focus on protecting, enhancing, or restoring complexes of various wetland types, especially estuarine aquatic-bed and intertidal unconsolidated substrate types.

Key words: wetlands, waterbird management, shorebirds, wading birds, coastal Texas, seabirds.

The coastal plains of Texas provide important habitat for wintering, migrating, and breeding waterfowl and waterbirds (Buller 1964; Stutzenbaker and Weller 1989). In this report, waterbirds include all birds that spend most of their time in or adjacent to water (e.g., grebes, pelicans, cormorants, wading birds, shorebirds, gulls, and terns) except waterfowl. More than 4 million birds that represent more than 100 species of waterbirds occupy this region in midwinter (Muehl 1994). Additionally, millions of waterbirds migrate through the Texas gulf coast area each year on their journeys to and from breeding and wintering areas (Muehl 1994).

At least 35 species of shorebirds and 20 species of wading birds use wetland habitats in coastal Texas (Muehl 1994). The most abundant species of birds include American white pelicans (*Pelecanus erythrorhynchos*), double-crested cormorants (*Phalacrocorax auritus*), cattle egrets (*Bubulcus ibis*), snowy egrets (*Egretta thula*), great egrets (*Casmerodius albus*), great blue herons (*Ardea herodias*), white-faced ibises (*Plegadis chihi*), white ibises (*Eudocimus albus*), American coots (*Fulica americana*), lesser yellowlegs (*Tringa flavipes*), long-billed dowitchers (*Limnodromus scolopaceus*), western sandpipers (*C. mauri*), least sandpipers (*Calidris minutilla*), laughing gulls (*Larus atricilla*), and ring-billed gulls (*L. delawarensis*).

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Federally listed endangered or threatened species (Texas Organization for Endangered Species 1988) that inhabit coastal Texas include brown pelicans (*Pelecanus occidentalis*), whooping cranes (*Grus americana*), and piping plovers (*Charadrius melodus*). Other species with potential threats to their current populations include wood storks (*Mycteria americana*), white-faced ibises, least terns (*Sterna antillarum*), and black skimmers (*Rynchops niger*). The abundances of shorebirds are particularly vulnerable to declines, and the populations of several species have already declined (Howe et al. 1989).

Texas lost more than 52% of its original wetland area by the early 1980's (Tiner 1984; Dahl 1990). Large ranches and the increasing human population along the Texas coast are expected to influence wetland management along the coast (Stutzenbaker and Weller 1989). As wetlands continue to be destroyed and degraded, preservation of the remaining natural wetlands, enhancement of constructed wetlands, and development of new wetlands take on more importance in the management and preservation of waterbird populations.

Information that is essential for habitat management of wintering and migrating waterbirds in coastal Texas and elsewhere is lacking (Fredrickson and Reid 1986; Smith et al. 1989). Information is available on the most important wetland types for wintering waterfowl in coastal Texas (Anderson 1994), but data on shorebirds, rails, wading birds, and seabirds generally are lacking. Knowledge of wetland preferences and needs of species that have received little attention become more important as biological diversity and community-oriented management issues are increasingly emphasized.

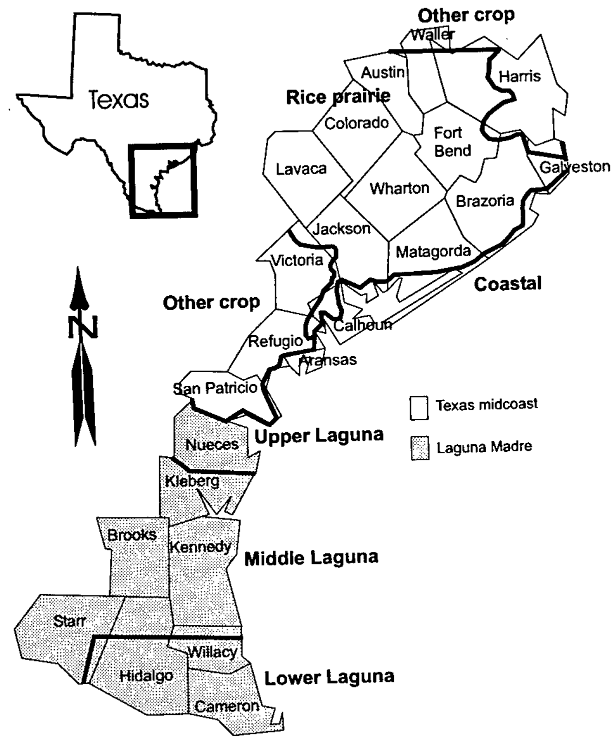

Figure. Location of Laguna Madre and Texas midcoast initiative areas and strata boundaries for waterbird habitat-use surveys conducted during September and November 1991-92 and January and March 1992-93.

Purpose and Scope

Our objectives were to rank the wetland types (1) by the density and feeding of waterbirds on the wetlands and (2) by the importance of the wetlands to migrating and wintering waterbirds.

Study Area

The study areas (Figure) were the Laguna Madre area from the Nueces River south to the Rio Grande and the midcoast area from the Nueces River north to Galveston Bay and as far inland as rice production occurs. Muehl et al. (1994) and Muehl (1994) provided detailed accounts of the study areas and of the number of wetlands by type in the areas.

Laguna Madre Area

Eight counties are in the 1,951,884-ha Laguna Madre area. The area consists of hyperhaline bays, river flood plains, and barrier islands (Anderson 1994) and is characterized by poor soil development and sparse vegetation. Sandy plains and coastal prairies dominate the inland landscape. Estuarine wetlands are the most abundant of the four wetland systems (Cowardin et al. 1979) in the Laguna Madre area (Muehl 1994).

The climate is semiarid with regular droughts (Norwine and Bingham 1986). The average high temperature is 30° C and the average low temperature is 16° C. The annual rainfall ranges from 80 cm in

the north to 55 cm in the south (Larkin and Bomar 1983). The annual evaporation rates exceed 175 cm.

Midcoast Area

The 3,552,505-ha midcoast area encompasses 16 Texas counties and is located primarily in the gulf prairie and gulf marsh ecological areas of Texas (McMahan et al. 1984). The potential native climax vegetation in the rice prairies is mostly tallgrass prairie with some post oak (*Quercus stellata*) savannah on upland areas (Gould 1969). The climax vegetation in the Gulf prairie is dominated by tall bunchgrasses that include big bluestem (*Andropogon gerardii*) and little bluestem (*Schizachyrium scoparium*). The climax vegetation in the gulf marsh areas includes rushes (*Juncus* spp.), sedges (*Carex* spp. and *Cyperus* spp.), bulrushes (*Scirpus* spp.), and cordgrasses (*Spartina* spp.). Palustrine wetlands are the most abundant of the four wetland systems (Cowardin et al. 1979) in the midcoast area (Muehl 1994).

The climate in this area is subtropical humid and noted for warm summers (Larkin and Bomar 1983). The average high temperature is 28° C and the average low temperature is 13° C. The average precipitation ranges from 133 cm in the north to 87 cm in the south (National Fibers Information Center 1987).

Methods

The Laguna Madre area was divided into upper, middle, and lower strata (Figure). The midcoast area was divided into coastal, other crop, and rice prairie strata. Strata were devised by land practices and physiographic region. A coastal stratum was not identified in the Laguna Madre area because palustrine wetlands in this area were not more abundant near the coast and because most estuarine wetland types were narrow or absent.

The other crop, upper, and lower strata consisted primarily of row crops, brush, and urban areas. The middle stratum was primarily native grassland and brush. The rice prairie stratum was dominated by rice production, but other crops, pasture, and woods were also present. The coastal stratum was a narrow strip along the coast and was dominated by coastal salt marsh and freshwater prairie wetlands.

In 1991-92, we used map coordinates to randomly select 222 64.75-ha plots in the strata of the Laguna Madre area and 290 64.75-ha plots along the midcoast. Plots were allocated in proportion to the area of each stratum. In the Laguna Madre area, 25 plots were allocated to the upper strata, 111 plots to the middle strata, and 86 plots to the lower strata. In the midcoast area, 25 plots were allocated to the coastal strata, 201 plots to the rice prairie strata, and 64 plots to the other crop strata.

In 1992-93, plots in each area were increased and reallocated among strata to decrease the variances of the estimated total population sizes of waterbirds (Muehl 1994). Sampling effort was increased in strata in each area where waterbirds were most abundant. The sample size in each stratum was made proportionate to the estimated total population size of the birds in the stratum (Kish 1965).

Total plots allocated in 1992-93 were 409 in the Laguna Madre and 600 in the midcoast area. In the Laguna Madre area, 136 plots were allocated to the upper strata, 46 plots to the middle strata, and 227 plots to the lower strata. In the midcoast area, 273 plots were allocated to the coastal strata, 241 plots to the rice prairie strata, and 86 plots to the other crop strata.

After the plots were randomly selected, permission to access them was obtained; if permission was not given, the area was replaced with another random sample. All plots were surveyed for wetlands, but not all plots contained wetlands. We did not conduct surveys on large bays, the Laguna Madre, island habitats, or national wildlife refuge lands with large expanses of coastal marsh. Ground surveys were impractical in these areas, and they were not included in the study area.

All waterbird counts and wetland classification on the stratified random sample of plots (Stewart and Kantrud 1972; Brewster et al. 1976; Heitmeyer 1980) were made during 2-week periods in late September and late November 1991-92 and in early January and late March 1992-93. During the first year of the study (1991-92), surveys were conducted during 14-28 September, 9-23 November, 4-18 January, and 14-28 March. During the second year (1992-93), surveys were conducted during 19 September-3 October, 21 November-5 December, 2-16 January, and 20 March-3 April.

The period from September to March was considered a count year. All wetlands on plots were visited once during each count period. The survey in September was timed to maximize the number of

observations of fall migrants. Surveys in November and January were timed to collect data on wintering habitat of all waterbirds. The survey in March was timed to include many migrants in spring.

Waterbird Counts

Only shorebirds, wading birds, and rails were counted during the first year of the study. During the second year, we also counted loons, grebes, pelicans, cormorants, gulls, and terns. All waterbirds on wetlands were recorded by species and enumerated, and the wetland type on which they were seen was identified. Birds that were not in a wetland but on the shore (within 2 m of water) were considered to be associated with that wetland.

An instantaneous scan sample was conducted of each species to record feeding (Altmann 1974). By species, we recorded the quotient of the number of feeding birds and the total number of sampled birds. All birds were first viewed at a distance to avoid interrupting normal behavior; rarely were birds disturbed, and disturbed birds were not used for the analysis.

Wetland Classification

All wetlands and deepwater habitats in the study areas were classified according to Cowardin et al. (1979). The wetlands and the deepwater habitat were considered to be wetlands for classification and discussion. System, subsystem, class, and subclass of each wetland were recorded following Cowardin et al. (1979). National Wetlands Inventory (U.S. Fish and Wildlife Service, unpublished) codes are used in the tables to identify wetland types (Table 1).

Data Analyses

We combined data across areas, count periods, and years for analyses of habitat use by birds. Count periods were sufficiently far enough apart in time (i.e., 2 months; Haukos and Smith 1993) to justify combining data and to assume that observations of the same wetland basin in successive count periods were independent. Wetlands served as the experimental unit. Only wetland types on which a species occurred and wetland types that were adequately sampled ($n > 3$) were used for that species analysis.

We calculated the density of each species on each wetland as number of birds per hectare of water, which included soil that was moist or saturated (e.g., moist tidal flats). All wetlands of a wetland type on which a species was observed were included in the analyses. The proportion of feeding bird (PFB) of each species was also calculated from the quotient of the number of feeding birds and the number of observed birds and was averaged over all wetlands of that subclass. All densities and PFB were rank transformed because (based on visual inspection) data were not normally distributed. We assumed that the rank-transformed data satisfied the assumptions of the parametric model better than the raw data (Conover and Iman 1981; Potvin and Roff 1993). Density and PFB ranks served as dependent variables in one-way analyses of variance (ANOVAs); independent variables were wetland types. Mean square error (MSE) was calculated with SAS (SAS Institute Inc. 1988). Modified Scheffe's procedure (with harmonic mean) was used with $\alpha = 0.10$ for rejection of the null hypothesis of equal means (SAS Institute Inc. 1988).

Habitat selection procedures followed Neu et al. (1974). Waterbirds were analyzed with flocks as the experimental unit (to avoid violating the independence assumption of aggregated individuals) if enough flocks ($n > 10$) were observed to allow a Chi-square approximation for the goodness-of-fit test statistic (Alldredge and Ratti 1986). For these analyses, a flock was considered to include all birds of a species on a wetland; by definition, only one flock of a species was considered to be using a wetland during each count period. Chi-square goodness-of-fit analyses were used to test the hypothesis that waterbirds used each wetland type in proportion to its availability. Estimates of wetland abundance were derived from Muehl et al. (1994) and Muehl (1994). When a significant difference in use versus availability was determined with Chi-square, a Bonferroni Z-statistic was used (Miller 1981) to determine which wetland types the birds used selectively or avoided.

Results

Eighty-eight species of waterbirds were observed on wetlands; we present results for 75 species that occurred on two or more wetland types (Table 2). The most abundant species included the American coot, dowitchers, and western sandpiper.

Table 1. Codes used for describing wetland subclasses observed on the coastal plains of Texas during September and November 1991-92 and January and March 1992-93.

Wetland subclass[a]	Code[b]	Wetland subclass[a]	Code[b]
Estuarine		**Riverine intermittent** continued	
subtidal		streambed mud	R4SB5
rock bottom bedrock	E1RB1	streambed organic	R4SB6
rock bottom rubble	E1RB2	streambed vegetated	R4SB7
unconsolidated bottom cobble-gravel	E1UB1	**Lacustrine**	
unconsolidated bottom sand	E1UB2	limnetic	
unconsolidated bottom mud	E1UB3	rock bottom rubble	L1RB2
unconsolidated bottom organic	E1UB4	unconsolidated bottom mud	L1UB3
aquatic-bed algal	E1AB1	littoral	
aquatic-bed rooted vascular	E1AB3	rock bottom bedrock	L2RB1
aquatic-bed floating vascular	E1AB4	rock bottom rubble	L2RB2
reef mollusk	E1RF2	unconsolidated bottom cobble-gravel	L2UB1
intertidal		unconsolidated bottom sand	L2UB2
aquatic-bed algal	E2AB1	unconsolidated bottom mud	L2UB3
aquatic-bed rooted vascular	E2AB3	unconsolidated bottom organic	L2UB4
reef mollusk	E2RF2	aquatic-bed algal	L2AB1
streambed cobble-gravel	E2SB1	aquatic-bed rooted vascular	L2AB3
streambed mud	E2SB3	aquatic-bed floating vascular	L2AB4
streambed organic	E2SB4	rocky shore rubble	L2RS2
rocky shore rubble	E2RS2	unconsolidated shore mud	L2US3
unconsolidated shore cobble-gravel	E2US1	unconsolidated shore organic	L2US4
unconsolidated shore sand	E2US2	unconsolidated shore vegetated	L2US5
unconsolidated shore mud	E2US3	emergent nonpersistent	L2EM2
unconsolidated shore organic	E2US4	**Palustrine**	
emergent persistent	E2EM1	rock bottom bedrock	PRB1
emergent nonpersistent	E2EM2	unconsolidated	
scrub-shrub broad-leaved deciduous	E2SS1	bottom cobble-gravel	PUB1
scrub-shrub needle-leaved evergreen	E2SS4	bottom sand	PUB2
Riverine		bottom mud	PUB3
tidal		bottom organic	PUB4
unconsolidated bottom mud	R1UB3	aquatic-bed	
unconsolidated bottom organic	R1UB4	algal	PAB1
unconsolidated shore mud	R1US3	rooted vascular	PAB3
unconsolidated shore organic	R1US4	floating vascular	PAB4
lower perennial		unconsolidated	
unconsolidated bottom cobble-gravel	R2UB1	shore cobble-gravel	PUS1
unconsolidated bottom sand	R2UB2	shore sand	PUS2
unconsolidated bottom mud	R2UB3	shore mud	PUS3
unconsolidated bottom organic	R2UB4	shore organic	PUS4
aquatic-bed algal	R2AB1	shore vegetated	PUS5
aquatic-bed rooted vascular	R2AB3	emergent	
aquatic-bed floating vascular	R2AB4	persistent	PEM1
unconsolidated shore sand	R2US2	nonpersistent	PEM2
unconsolidated shore mud	R2US3	scrub-shrub	
emergent nonpersistent	R2EM2	broad-leaved deciduous	PSS1
upper perennial		broad-leaved evergreen	PSS3
unconsolidated bottom cobble-gravel	R3UB1	needle-leaved evergreen	PSS4
intermittent		scrub-shrub dead	PSS5
streambed bedrock	R4SB1	forested broad-leaved deciduous	PFO1
streambed sand	R4SB4	forested dead	PFO5

[a]Wetland subclasses from Cowardin et al. (1979).
[b]Codes are from National Wetlands Inventory (1985).

Grebes

Eared grebes (*Podiceps nigricollis*) used seven wetland types that represented 36.8% of the available wetland habitat. Density ranks did not differ among wetlands used. Proportion of feeding bird ranks varied ($F = 2.59$; 6, 1,688 df; $P = 0.017$) among wetland types and were highest in wetlands with less than 30% vegetation, especially lacustrine limnetic unconsolidated bottom mud and palustrine unconsolidated bottom organic wetlands.

Table 2. Number of wetland types on which birds were seen and number of birds and flocks of waterbird species observed on wetlands in the coastal plains of Texas during September and November 1991-92 and January and March 1992-93.

Species	Wetland types (no.)	Birds (no.)	Flocks (no.)	Species	Wetland types (no.)	Birds (no.)	Flocks (no.)
Eared grebe	7	180	19	Semipalmated plover	10	384	33
Pied-billed grebe	29	1,078	235	Killdeer	48	1,542	427
Least grebe	9	328	39	Black-bellied plover	17	3,278	121
American white pelican	27	2,446	126	American golden plover	11	133	16
Brown pelican	10	86	26	Marbled godwit	8	100	21
Anhinga	14	163	32	Whimbrel	8	40	16
Neotropic cormorant	20	291	48	Long-billed curlew	24	810	172
Double-crested cormorant	31	4,104	191	Willet	23	2,597	283
Least bittern	4	27	10	Greater yellowlegs	27	1,259	207
American bittern	10	53	43	Lesser yellowlegs	28	1,186	162
Black-crowned night-heron	25	532	101	Solitary sandpiper	16	36	21
Yellow-crowned night-heron	13	127	32	Spotted sandpiper	27	198	72
Green heron	26	173	18	Dowitchers	29	23,498	180
Tricolored heron	32	760	298	Stilt sandpiper	7	113	9
Little blue heron	29	813	189	Common snipe	25	726	110
Reddish egret	14	145	107	Ruddy turnstone	10	140	24
Cattle egret	21	1,751	81	Red knot	10	333	13
Snowy egret	52	754	165	Dunlin	9	6,784	28
Great egret	49	1,901	631	Sanderling	12	395	26
Great blue heron	45	1,269	719	Semipalmated sandpiper	7	901	13
Wood stork	4	76	7	Western sandpiper	34	18,602	161
White-faced ibis	18	6,404	122	Least sandpiper	20	10,195	84
White ibis	26	1,610	173	White-rumped sandpiper	7	329	19
Roseate spoonbill	16	611	81	Upland sandpiper	4	8	4
Whooping crane	3	10	4	Franklin's gull	3	26	4
King rail	6	52	27	Laughing gull	34	14,331	313
Clapper rail	10	333	86	Bonaparte's gull	4	21	4
Virginia rail	3	11	9	Ring-billed gull	22	2,438	91
Sora	8	52	28	Herring gull	17	244	55
Purple gallinule	27	2,446	126	Common tern	15	64	21
Common moorhen	23	2,082	165	Forster's tern	17	328	68
American coot	29	22,803	274	Gull-billed tern	11	373	45
American oystercatcher	9	21	13	Least tern	19	328	68
American avocet	20	2,085	75	Sandwich tern	6	37	8
Black-necked stilt	27	1,086	128	Royal tern	9	107	20
Snowy plovers	8	185	15	Caspian tern	19	475	75
Piping plover	8	29	11	Black skimmer	8	1,569	18
Wilson's plover	10	144	24				

Pied-billed grebes (*Podilymbus podiceps*) used 29 wetland types that represented 90.8% of the available wetland habitat. Density and PFB ranks were highest in wetlands with more than 30% rooted vascular or floating vascular vegetation, especially in lacustrine littoral aquatic-bed rooted vascular or lacustrine littoral aquatic-bed floating vascular wetlands (Table 3A). The grebes selectively used palustrine aquatic-bed rooted vascular and palustrine unconsolidated bottom mud wetlands.

Least grebes (*Tachybaptus dominicus*) used nine wetland types that represented 47.6% of the available wetland habitat. Density ($F = 12.47$; 8, 2,037 df; $P < 0.001$) and PFB ($F = 14.94$; 8, 2,037 df; $P < 0.001$) ranks were highest in wetlands with more than 30% vegetation, especially in lacustrine littoral aquatic-bed rooted vascular or lacustrine littoral aquatic-bed

Table 3. Wetland selection and analysis of variance results of rank transformation of density (number per hectare) and proportion of feeding birds in flocks that used various wetland types[a] in the coastal plains of Texas during specific months in 1991-93.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
A. Pied-billed grebes						1,078	235	29	9/92, 11/92; 1/93, 3/93
L2AB3	1	A	1	A					
L2AB4	2	B	2	B					
R2AB3	3	BC	3	BC					
PAB3	4	BC	4	BC	+				
L2UB3	5	BC	5	BC	0				
E1UB4	6	BC	6	BC					
E1AB3	7	BC	7	BC	0				
E2AB3	8	BC	8	BC	0				
L1UB3	9	BC	9	BC	0				
PAB1	10	BC	11	BC					
PUB2	11	BC	10	BC					
PUB4	12	BC	23	C					
E1UB2	13	C	12	BC					
R2AB4	14	C							
PSS1	15	C	13	C	0				
PEM1	16	C	15	C	0				
E2AB1	17	C	14	C	0				
E2SB3	18	C	16	C					
PAB4	19	C	17	C					
E2US3	20	C	18	C	-				
PUB3	21	C	21	C	+				
R1UB3	22	C	19	C					
E2US4	23	C	20	C	-				
E1UB3	24	C	22	C	-				
E2EM1	25	C	25	C	-				
E2US2	26	C	24	C					
PEM2	27	C	27	C					
PUS5	28	C	26	C					
PUS4	29	C		C	-				
B. American white pelican						2,446	126	27	9/92, 11/92; 1/93, 3/93
E1UB1	1	A							
E1UB4	2	AB	3	ABC					
L2UB2	3	B	1	A					
E1UB2	4	B	2	AB					
E1AB3	5	B	4	ABC	0				
E2AB3	6	B	5	ABC	0				
E2SS4	7	B							
L1UB3	8	B	12	ABC	0				
E2AB1	9	B	11	ABC					
E2US4	10	B	13	ABC					
L2UB3	11	B	17	ABC	0				
E2US5	12	B	6	ABC					
E2US3	13	B	15	ABC	0				
E1AB1	14	B	7	ABC					
L2AB4	15	B	8	ABC					
L2AB3	16	B	9	ABC					
E2EM2	17	B	10	ABC					
E1UB3	18	B	19	BC	0				

A. Pied-billed grebes:

Density ranks varied (F = 18.73; 28, 4,041 df; MSE = 206,812; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied (F = 15.35; 26, 3,271 df; MSE = 142,517; $P < 0.001$) among wetland types for this species.

Wetland selection varied (X^2 = 683.04; 14 df; $P < 0.001$) among wetland types for this species.

B. American white pelican:

Density ranks varied (F = 11.34; 26, 3,258 df; MSE = 92,056; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied (F = 7.07; 20, 2,323 df; MSE = 28,877; $P < 0.001$) among wetland types for this species.

Wetland selection varied (X^2 = 80.44; 9 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
B. American white pelican continued									
PAB3	19	B	18	BC	0				
R1UB3	20	B	14	ABC					
PAB1	21	B	16	ABC					
R2UB3	22	B							
E2EM1	23	B	20	BC	-				
PEM2	24	B							
PSS1	25	B							
PUB3	26	B							
PEM1	27	B	21	C	-				
C. Double-crested cormorants						4,104	191	31	11/92; 1/93, 3/93
L2UB1	1	A	8						
L2AB4	2	AB	3						
L1UB3	3	ABC	1		0				
L2UB3	4	ABC	5		0				
E1UB4	5	ABC	2						
E1AB3	6	ABC	6		0				
L2AB3	7	ABC	10						
E1AB1	8	ABC	4						
E1UB3	9	ABC	11		0				
E2EM2	10	ABC	7						
E2AB3	11	ABC	18		0				
PSS5	12	ABC	9						
E2US2	13	ABC	17						
E2US3	14	ABC	14		0				
E1UB2	15	ABC							
PAB1	16	BC							
PUB1	17	BC							
E2AB1	18	BC	12						
PUB2	19	BC	13						
R2UB4	20	BC							
PAB3	21	BC	15		-				
PAB4	22	BC	16						
PUB4	23	C	19						
R1UB3	24	C							
E2US4	25	C			-				
PEM1	26	C	21		-				
PSS1	27	C	24						
E2EM1	28	C	20		-				
PUB3	29	C	22		0				
PUS3	30	C	23						
R2UB3	31	C	25						
D. Black-crowned night-herons						532	101	25	9/91-92, 11/91-92; 1/92-93, 3/93
E2SS4	1	A							
PSS4	2	AB							
R2AB4	3	BC	3	AB					
R2AB3	4	BC	1	A					
E2AB3	5	BC			0				
E2EM2	6	BC	2	AB					
E1UB4	7	BC							

Density ranks varied ($F = 12.77$;30, 2,672 df; MSE = 106,315; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 9.24$; 24, 2,542 df; MSE = 53,441; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 77.10$; 11 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
D. Black-crowned night-herons continued									
E1AB3	8	BC			0				
PAB3	9	BC							
E2EM1	10	BC	6	B	0				
PAB1	11	BC							
L1UB3	12	BC			0				
PUB2	13	BC	4	B					
E1UB3	14	BC	9	B	0				
PEM1	15	BC	10	B	-				
E2US2	16	BC							
L2UB3	17	BC	5	B	-				
R2UB3	18	BC							
PSS1	19	BC	8	B					
E2US3	20	BC			0				
PEM2	21	BC							
PUB3	22	BC							
PUS3	23	C	7	B					
R4SB5	24	C							
PUS4	25	C	11	B					

Density ranks varied ($F = 5.44$; 24, 5,347 df; MSE = 128,023; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 4.66$; 10, 3,346 df; MSE = 14,046; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 71.26$; 8 df; $P < 0.001$) among wetland types for this species.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
E. Tricolored herons						760	298	32	9/91-92, 11/91-92; 1/93, 3/93
L2UB2	1								
PSS4	2		6						
E2US4	3		1		0				
E2SS1	4		2						
E2AB3	5		3		0				
E2EM1	6		7		+				
E2AB1	7		11		0				
L2AB3	8		4						
L2AB4	9		5						
E2EM2	10		8						
E2US2	11		10		0				
L2RB2	12		9						
E2US3	13		13		0				
R2AB4	14		12						
E2US1	15								
E1AB3	16		14		0				
R4SB3	17		15						
E1UB3	18		21		0				
PAB3	19		19						
E1UB4	20		16						
L2UB3	21		20		-				
PAB1	22		18						
E1AB1	23		17						
PAB4	24		25						
PEM1	25		24		-				
PSS1	26		23						
L1UB3	27		22		-				
PUB3	28		26		0				
PEM2	29		28						
R2UB3	30		27						

Density ranks varied ($F = 11.96$; 31, 3,945 df; MSE = 253,090; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 12.05$; 27, 3,777 df; MSE = 184,517; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 110.37$; 12 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
E. Tricolored herons continued									
PUB4	31								
L2US4	32								
F. Little blue herons						813	189	29	9/91-92, 11/92; 1/93, 3/92-93
L2EM2	1	A	1	A					
PSS4	2	AB	2	AB					
E2US4	3	BC	4	BC	0				
PSS5	4	BC	3	BC					
E2AB3	5	BC	5	BC	0				
L2AB4	6	BC	11	C					
E1UB4	7	BC	6	BC					
E2RF2	8	BC	7	BC					
E2EM1	9	BC	8	BC	0				
E1UB2	10	BC	9	C					
E2SS1	11	BC	10	C					
PAB3	12	BC	14	C					
E2EM2	13	BC	12	C					
E2US2	14	BC	17	C					
E2US3	15	BC	19	C	0				
R1UB3	16	BC	15	C					
E1AB3	17	BC	13	C	0				
PEM1	18	BC	20	C	0				
E1AB1	19	BC	21	C					
PUS2	20	BC	16	C					
L2UB3	21	BC	23	C	-				
PAB4	22	BC	18	C					
PSS1	23	C	22	C					
PEM2	24	C	24	C					
E1UB3	25	C	25	C	-				
PUB3	26	C	27	C	0				
PUS5	27	C	26	C					
R2UB3	28	C	28	C					
PUS4	29	C	29	C					

Density ranks varied ($F = 8.34$; 28, 4,636 df; MSE = 202,729; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 9.01$; 28, 4,622 df; MSE = 154,839; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 62.33$; 9 df; $P < 0.001$) among wetland types for this species.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
G. Cattle egrets						1,751	81	21	9/91-92; 3/92-93
L2AB4	1	A	1	A					
L2AB3	2	A	2	A					
L2US4	3	AB	4	AB					
PUB2	4	AB	5	B					
R2AB3	5	AB	3	AB					
E2EM2	6	AB							
L1UB3	7	AB							
PAB4	8	AB	6	B					
PEM1	9	AB	8	B	0				
E2US4	10	AB	7	B					
E2EM1	11	B	11	B	-				
R4SB5	12	B	9	B					
PAB3	13	B	10	B					
PUB3	14	B	15	B	0				
PUS5	15	B							
E2US3	16	B	12	B	-				

Density ranks varied ($F = 5.49$; 20, 2,229 df; MSE = 42,274; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 5.41$; 16, 1,900 df; MSE = 24,711; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 76.45$; 5 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
G. Cattle egrets continued									
PUS3	17	B	13	B					
PEM2	18	B	14	B					
PUS4	19	B	17	B					
PSS1	20	B	16	B					
E1UB3	21	B			-				
H. Snowy egrets						754	165	52	9/91-92, 11/92, 1/92-93, 3/93
L2EM2	1		1						
L2US3	2		2						
R3UB1	3								
E2US4	4		3		0				
E2AB1	5		4		0				
E2AB3	6		6		0				
E2EM2	7		5		0				
L2AB3	8		13		0				
L2UB2	9								
L2US5	10		8						
E2US2	11		10		0				
E1UB4	12		7		0				
L1UB3	13		20		0				
E2SS1	14		9						
E2US3	15		16		0				
E1AB3	16		19		0				
R1US3	17								
L2UB3	18		23		-				
L2AB4	19		12		0				
E1UB1	20								
PSS4	21		11						
E2EM1	22		17		0				
PSS5	23		15						
E2US1	24								
L2RB2	25								
PAB3	26		22		+				
E2SS4	27								
E2RS2	28		14						
E1UB2	29		18						
E1UB3	30		26		0				
E2RF2	31		21						
E1AB1	32								
PAB4	33		28						
PEM1	34		27		-				
R2AB3	35								
L2RB1	36		24						
PUB4	37		30		0				
R1UB3	38		29						
PUB2	39		25						
R2UB3	40		33		0				
L2UB1	41				-				
E2SB3	42		31						
PUB1	43								

Density ranks varied ($F = 8.95;51, 5,574$ df; MSE = 613,634; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 11.17$; 39, 5,301 df; MSE = 417,704; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 301.02$; 23 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
H. Snowy egrets continued									
PUB3	44		34		+				
PSS1	45		32		0				
PAB1	46		37						
PUS3	47		38						
R4SB5	48		36						
L2US4	49		35		-				
PEM2	50								
PUS5	51		39						
PUS4	52		40		0				
I. Great egrets						1,901	631	49	9/91-92,11/91-92, 1/92-93, 3/93
L2EM2	1	A	1	A					
L2AB4	2	AB	2	AB	0				
L1RB2	3	AB	3	AB					
E1UB1	4	AB	9	B					
E2AB3	5	AB	4	B	0				
E2EM1	6	AB	6	B	0				
E2US4	7	AB	5	B	0				
E2AB1	8	AB	7	B	0				
L2US5	9	AB							
E2US3	10	AB	10	B	0				
E1UB4	11	AB	8	B	0				
E2SS4	12	AB	27	B					
PAB3	13	B	15	B	+				
PSS4	14	B	11	B					
L2UB3	15	B	16	B	-				
E1AB3	16	B	14	B	0				
PSS5	17	B	13	B					
E2EM2	18	B	12	B					
L2RB2	19	B							
L1UB3	20	B	22	B	-				
L2AB3	21	B	17	B	0				
PEM1	22	B	23	B	-				
E2RF2	23	B	18	B					
E1UB3	24	B	29	B	0				
R2UB1	25	B	19	B					
E2US2	26	B	21	B	0				
L2UB1	27	B	20	B	-				
PUB1	28	B	33	B					
PUS2	29	B	24	B					
PEM2	30	B	30	B	0				
PAB4	31	B	26	B					
PUB2	32	B	28	B					
E1UB2	33	B	25	B					
R2UB4	34	B	37	B					
R2AB4	35	B	31	B					
R4SB5	36	B	35	B	0				
PSS1	37	B	41	B	0				
E2SB3	38	B	32	B					
R2UB3	39	B	40	B	0				
PUB3	40	B	38	B	+				

Density ranks varied ($F = 13.38$; 48, 5,965 df; MSE = 776,105; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 15.74$; 44, 5,845 df; MSE = 586,519; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 370.62$; 26 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
I. Great egrets continued									
R4SB7	41	B	34	B					
PAB1	42	B	39	B					
PUS5	43	B	36	B	0				
L2US4	44	B	42	B	-				
E1AB1	45	B							
PUS3	46	B	43	B	0				
PUB4	47	B	44	B	0				
R1UB3	48	B							
PUS4	49	B	45	B	0				
J. Great blue herons						1,269	719	45	9/91-92, 11/91-92, 1/92-93, 3/93
E1UB1	1	A							
E2RF2	2	AB	9						
L1RB2	3	AB	7						
E2US4	4	AB	1		-				
E2AB3	5	AB	3		0				
E2SS1	6	AB	24		0				
E2US2	7	AB	10		+				
R2UB1	8	AB	20						
E1UB4	9	AB	4		0				
L2EM2	10	AB	2						
E2EM1	11	AB	6		+				
L2RB2	12	AB							
E2SB3	13	AB	8						
E1AB3	14	AB	13		0				
E2AB1	15	AB	5		0				
R1UB3	16	AB	16		0				
L2UB3	17	AB	11		0				
PAB3	18	AB	19		+				
E1UB3	19	AB	22		0				
E2US3	20	AB	23		+				
L2AB3	21	B	18		+				
PSS4	22	B	12						
PSS5	23	B	14						
L1UB3	24	B	26		0				
R2AB4	25	B	15						
L2UB1	26	B	21		0				
E1UB2	27	B	25						
L2AB4	28	B	17		0				
E2EM2	29	B	30						
PEM1	30	B	28		+				
PSS1	31	B	27		+				
R4SB5	32	B	31		+				
R2UB3	33	B	37		+				
PEM2	34	B	36		-				
PUB3	35	B	32		+				
PAB4	36	B	29						
PAB1	37	B	35						
PUB4	38	B	42		0				
L2US4	39	B	33		0				

Density ranks varied ($F = 14.83$; 44, 5,894 df; MSE = 855,953; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 13.15$; 42, 5,819 df; MSE = 581,068; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 17{,}537.33$; 26 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
J. Great blue herons continued									
E1AB1	40	B	34						
PUS5	41	B	39						
R2UB4	42	B	38						
PUS4	43	B	41		+				
PUB2	44	B	40						
PUS3	45	B	43						
K. White-faced ibises						6,404	122	18	9/91-92, 11/91-92, 1/93, 3/93
L2AB4	1		1						
L2AB3	2		2						
E2AB3	3		3		0				
E2AB1	4		6						
PAB3	5		5		+				
PEM1	6		7		+				
E2EM2	7		4						
E2US3	8		8		0				
L2US4	9								
E2EM1	10		9		-				
PSS1	11		10						
PFO1	12								
PUB4	13		12						
E2US2	14		11						
PAB1	15								
PEM2	16		13						
E1UB3	17		14		-				
PUB3	18		15						
L. White ibises						1,610	173	26	9/91-92, 11/91-92, 1/92-93
L2UB2	1	1	A						
L2US5	2	2	AB						
PSS5	3	3	AB						
E2AB1	4	4	AB						
E2US4	5	6	AB						
E2AB3	6	5	AB	0					
E2EM1	7	8	AB	+					
E1UB4	8	7	AB						
E2SS1	9								
PAB3	10	9	AB	+					
L2AB3	11	10	AB						
L2AB4	12	11	AB						
E2US3	13	12	AB	0					
L1UB3	14			0					
PAB4	15	15	AB						
PEM1	16	14	AB	-					
PSS1	17	13	AB	0					
PAB1	18	16	AB						
L2UB3	19			-					
PEM2	20	18	AB						
PUS3	21	19	B						
E1AB3	22	17	AB	-					
PUB4	23								

Density ranks varied ($F = 4.69$; 17, 3,350 df; MSE = 97,267; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 5.02$; 14, 3,212 df; MSE = 66,404; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 85.33$; 6 df; $P < 0.001$) among wetland types for this species.

Density ranks varied ($F = 12.35$; 25, 3,802 df; MSE = 147,314; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 14.33$; 21, 3,612 df; MSE = 116,713; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 158.88$; 10 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
L. White ibises continued									
E1UB3	24		20	B	-				
PUS4	25		21	B					
PUB3	26		22	B					
M. Roseate spoonbills						611	81	16	9/91-92, 11/91-92, 1/93, 3/93
E1UB4	1	A	1	A					
PSS4	2	AB	2	AB					
E2US4	3	ABC	3	AB					
E2AB3	4	ABCD	4	ABC	0				
E2AB1	5	ABCD	6	BCD					
L2UB3	6	BCD	5	BCD	0				
E2EM2	7	BCD	16	D					
E2US2	8	BCD	9	BCD					
E2EM1	9	BCD	7	BCD	0				
E2US3	10	BCD	8	BCD	0				
PAB3	11	BCD	10	CD	0				
PAB4	12	BCD	11	D					
PSS1	13	CD	12	D					
E1UB3	14	D	13	D	0				
PEM1	15	D	14	D	-				
PUB3	16	D	15	D					

Density ranks varied ($F = 10.31$; 15, 3,108 df; MSE = 59,015; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 10.42$; 15, 3,106 df; MSE = 50,402; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 77.57$; 7 df; $P < 0.001$) among wetland types for this species.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
N. Common moorhens						2,082	165	23	9/92, 11/91-92, 1/93, 3/93
L2AB4	1	A	1	A					
L2AB3	2	A	2	A					
PAB3	3	B	3	B	+				
R2AB3	4	B	4	B					
R2AB4	5	B	9	B					
L1UB3	6	B	6	B	0				
PSS5	7	B	5	B					
PAB1	8	B	7	B					
PEM1	9	B	11	B	+				
L2UB1	10	B	8	B					
PFO1	11	B	10	B					
PSS1	12	B	12	B	0				
PAB4	13	B	13	B					
E2AB1	14	B	14	B					
PUB2	15	B							
E2US3	16	B			-				
L2UB3	17	B	15	B	-				
PUB4	18	B	16	B					
PUB3	19	B	17	B					
E2AB3	20	B			-				
E2EM1	21	B	19	B	-				
E1UB3	22	B			-				
R2UB3	23	B	18	B					

Density ranks varied ($F = 22.61$; 22, 3,388 df; MSE = 117,642; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 24.45$; 18, 2,678 df; MSE = 72,728; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 741.84$; 9 df; $P < 0.001$) among wetland types for this species.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
O. American coots						22,803	274	29	9/91-92, 11/91-92, 1/92-93, 3/92-93
L2AB3	1	A	1	A	+				
L2AB4	2	B	2	B					

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
O. American coots continued									
E1UB1	3	BC	3	BC					
L2RB2	4	BCD	4	BCD					
L2UB1	5	BCDE	6	CD	0				
L2UB3	6	BCDE	5	BCD	0				
L1UB3	7	BCDE	11	CD	0				
E2AB1	8	BCDE	7	CD	0				
PAB3	9	BCDE	8	CD					
PUB4	10	BCDE	15	CD	0				
E1AB3	11	BCDE	13	CD	0				
E1UB4	12	CDE	9	CD					
E2AB3	13	CDE	10	CD	0				
PAB1	14	CDE	12	CD					
PEM1	15	CDE	16	D	0				
PAB4	16	CDE	14	CD					
R2UB4	17	CDE	29	D					
E2US4	18	DE	17	D	0				
E2US3	19	DE	24	D	0				
L2US4	20	DE	22	D	-				
E1AB1	21	DE	18	D					
PSS1	22	DE	19	D					
E1UB3	23	DE	25	D	-				
R1UB3	24	DE	20	D					
PFO1	25	DE	21	D					
PUB3	26	DE	23	D	+				
R2UB3	27	DE	28	D					
PEM2	28	E	27	D					
E2EM1	29	E	26	D	-				
P. American avocets						2,085	75	20	9/91-92, 11/91-92, 1/92-93, 3/92-93
E1UB1	1	A	1	A					
PSS4	2	B	20	C					
E2EM2	3	BC	2	AB					
E2US4	4	BC	3	ABC					
E2US3	5	BC	7	ABC	+				
E2AB3	6	BC	4	ABC	0				
E2US2	7	BC	8	ABC					
E2US1	8	BC	5	ABC					
E2AB1	9	BC	10	BC					
E1UB4	10	BC	6	ABC					
R1UB3	11	BC	9	BC					
E1UB3	12	BC	11	BC	0				
E2EM1	13	BC	14	BC	-				
PAB1	14	BC	12	BC					
PAB3	15	BC	13	BC					
R2UB3	16	BC	15	BC					
PUB4	17	BC	16	C					
PEM2	18	BC	17	C					
PEM1	19	C	19	C	-				
PUB3	20	C	18	C					

American coots:

Density ranks varied ($F = 15.02$; 28, 4,457 df; MSE = 265,717; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 18.42$; 28, 4,431 df; MSE = 200,286; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 454.78$; 15 df; $P < 0.001$) among wetland types for this species.

American avocets:

Density ranks varied ($F = 11.16$; 19, 3,868 df; MSE = 68,138; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 8.91$; 19, 3,867 df; MSE = 52,561; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 83.93$; 5 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
Q. Black-necked stilts						1,086	128	27	9/91-92, 3/92-93
E2AB3	1		3		0				
E2US4	2		6						
E2EM2	3		2						
E2AB1	4		1						
E2US3	5		5		0				
E1UB2	6		4						
L2US4	7		7						
E2US2	8		8						
PAB3	9		9		0				
E1UB3	10		13		0				
L1UB3	11				0				
L2UB3	12		14		0				
E1AB1	13		10						
R1UB3	14		11						
PAB1	15		17						
PUB4	16		15						
E2EM1	17		20		-				
E1AB3	18		12		-				
PSS1	19		16						
PEM1	20		19		-				
PEM2	21		18						
R2UB3	22		21						
PUS5	23								
PUS3	24		22						
PUB3	25		23						
PUS4	26								
E2SS1	27								
R. Killdeer						1,542	427	48	9/91-92, 11/91-92, 1/92-93, 3/92-93
L2UB2	1		2						
L2US5	2		1						
E1UB1	3								
E2US4	4		4		0				
L2US3	5		3						
L2AB3	6		5						
E1RF2	7		6						
E2US1	8		19						
E2RF2	9		7						
E2US3	10		11		0				
E2AB1	11		9		0				
PSS4	12		8						
E2US2	13		13		0				
L2US4	14		24		+				
E2AB3	15		12		0				
E2EM2	16		10						
E2SS1	17		23						
R2AB1	18		14						
L2AB4	19		15		0				
L2RB2	20		16						
PAB3	21		17						
E1UB4	22		25		0				
E2SB3	23		18						

Black-necked stilts:

Density ranks varied ($F = 5.53$; 26, 2,560 df; MSE = 75,356; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 5.45$; 22, 2,148 df; MSE = 41,966; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 107.15$; 9 df; $P < 0.001$) among wetland types for this species.

Killdeer:

Density ranks varied ($F = 6.52$; 47, 6,177 df; MSE = 595,268; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 6.54$; 45, 6,114 df; MSE = 418,627; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 562.75$; 18 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
R. Killdeer continued									
R2UB1	24								
E2EM1	25		22		-				
E1AB3	26		27		-				
R4SB7	27		30		-				
L2UB3	28		26						
PSS5	29		21						
PUS2	30		20		+				
R4SB6	31		29						
PSS1	32		35						
E1UB3	33		32		-				
L1UB3	34		31						
PEM1	35		36		+				
R1UB3	36		39						
PUB3	37		33						
L2UB1	38		28		-				
PUS4	39		38		-				
PAB1	40		40						
E1AB1	41		34						
PAB4	42		37						
PUS5	43		42						
PUS3	44		41						
PUB4	45		43		+				
PEM2	46		44						
R4SB5	47		45						
R2UB3	48		46		0				
S. Black-bellied plovers						3,278	121	17	9/91-92, 11/91-92, 1/92-93, 3/93
E2RF2	1	A	2	AB					
E2RS2	2	AB	1	A					
E2US4	3	ABC	3	ABC	0				
E1RF2	4	ABCD	4	ABC					
E1UB1	5	BCD	17	C					
E2US1	6	CD	5	BC					
E2US2	7	CD	7	BC					
E1UB2	8	CD	6	BC					
E2US3	9	CD	10	BC	+				
E2AB3	10	CD	11	BC	0				
E2AB1	11	CD	8	BC	0				
E1UB4	12	CD	9	BC					
E1AB3	13	CD	12	BC	0				
E2EM1	14	CD	13	C	-				
E1UB3	15	CD	14	C	-				
PUS4	16	D	15	C	0				
PUB3	17	D	16	C					

Density ranks varied ($F = 25.28$; 16, 2,911 df; MSE = 75,031; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 20.55$; 16, 2,911 df; MSE = 60,202; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 76.43$; 8 df; $P < 0.001$) among wetland types for this species.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
T. Long-billed curlews						810	172	24	9/91-92, 11/91-92, 1/92-93, 3/92-93
E2EM2	1	A	1	A					
E2US4	2	AB	5	AB	0				
E1UB2	3	ABC	2	A					

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
T. Long-billed curlews continued									
E1UB4	5	ABC	4	AB					
E2AB3	6	ABC	8	AB	0				
E2US1	7	ABC	6	AB					
E2EM1	8	ABC	9	AB	0				
E1AB3	9	ABC	13	AB	0				
E2RF2	10	ABC	7	AB					
E2US3	11	ABC	10	AB	0				
E2US2	12	ABC	12	AB					
E2SS1	13	ABC	11	AB					
L2AB3	14	ABC							
E1UB3	15	BC	14	AB	0				
L2US4	16	BC			-				
PEM1	17	C	16	B	-				
PUS4	18	C	17	B	0				
PUB4	19	C	15	B					
PEM2	20	C							
PAB3	21	C							
PUS3	22	C							
R4SB5	23	C	18	B					
PUB3	24	C							

Density ranks varied ($F = 19.55$; 23, 5,010 df; MSE = 192,841; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 15.19$; 17, 3,814 df; MSE = 112,397; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 76.98$; 9 df; $P < 0.001$) among wetland types for this species.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
U. Willets						2,597	283	23	9/91-92, 11/91-92, 1/92-93, 3/92-93
E2RS2	1	A	1	A					
E1UB1	2	AB	5	AB					
E1RF2	3	ABC	9	AB					
E2US1	4	ABC	6	AB					
E2RF2	5	ABC	2	AB					
E2US4	6	ABC	7	AB	0				
E2EM2	7	ABC	3	AB					
L2US3	8	ABC	4	AB					
E2US2	9	ABC	10	AB	+				
E2AB3	10	ABC	8	AB	+				
E1UB4	11	ABC	11	AB					
E1AB3	12	ABC	12	AB					
E2AB1	13	ABC	13	AB	0				
E2US3	14	ABC	14	B	+				
E1RB1	15	ABC							
E1UB2	16	ABC	15	B					
E2EM1	17	ABC	16	B	0				
E1UB3	18	BC	17	B	0				
E1AB1	19	C							
PUB3	20	C	18	B	0				
PUS5	21	C							
PAB3	22	C	19	B					
PEM1	23	C	20	B	-				

Density ranks varied ($F = 28.20$; 22, 3,456 df; MSE = 193,446; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 25.92$; 19, 3,260 df; MSE = 149,089; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 235.71$; 9 df; $P < 0.001$) among wetland types for this species.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
V. Greater yellowlegs						1,259	207	27	9/91-92, 11/91-92, 1/92-93, 3/92-93
E2US4	1	A	1	A	0				
E2AB3	2	AB	3	AB	+				
E1RF2	3	AB	2	AB					

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
V. Greater yellowlegs continued									
PSS4	4	AB	4	AB					
E2US3	5	AB	5	AB	+				
E2US2	6	AB	8	AB	0				
R3UB1	7	AB	6	AB					
E2EM2	8	AB	7	AB					
E1AB3	9	AB	9	AB	0				
E2AB1	10	B	11	AB					
E2EM1	11	B	10	AB	0				
L2US4	12	B	14	B	0				
E1UB4	13	B							
E1UB3	14	B	12	AB	0				
L2UB3	15	B	15	B	-				
PAB3	16	B	13	B					
PSS1	17	B	16	B					
PEM1	18	B	18	B	-				
PAB4	19	B	17	B					
PUS3	20	B	19	B					
PUB3	21	B	20	B					
PUB4	22	B							
PUS4	23	B	24	B	0				
PEM2	24	B	21	B					
PUS5	25	B	22	B					
R2UB3	26	B	23	B					
R1UB3	27	B							

Density ranks varied ($F = 19.79$; 26, 5,600 df; MSE = 258,243; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 19.52$; 23, 5,400 df; MSE = 203,550; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 116.81$; 11 df; $P < 0.001$) among wetland types for this species.

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
W. Lesser yellowlegs						1,186	162	28	9/91-92, 11/91-92, 1/92-93, 3/92-93
E2US4	1		1		0				
E1UB1	2		3						
PSS4	3		2						
E2AB1	4		4						
E2RS2	5		5						
E2AB3	6		6		0				
E2US3	7		7		+				
R3UB1	8								
E2EM2	9		8						
E2US2	10		10						
E2RF1	11		9						
E2SS1	12		11						
E2EM1	13		12		0				
E1UB4	14		13						
E2SB3	15		14						
PAB3	16		15						
E1UB3	17		18		0				
E1AB3	18		16		-				
PAB1	19		17						
R4SB6	20		19						
L1UB3	21				-				
L2US4	22				-				
PEM2	23		20						
PEM1	24		21		-				

Density ranks varied ($F = 11.64$; 27, 4,988 df; MSE = 186,043; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 12.78$; 24, 4,890 df; MSE = 164,653; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 104.08$; 9 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
W. Lesser yellowlegs continued									
PUB4	25		22						
PUB3	26		23						
PSS1	27		24						
PUS4	28		25						
X. Dowitchers						23,498	180	298	9/91-92, 11/91-92, 1/92-93, 3/92-93
E1UB1	1	A	1	A					
L2US3	2	A	2	AB	+				
PSS5	3	AB	3	ABC					
E2AB3	4	ABC	4	ABCD	0				
E2US3	5	ABC	5	BCD	+				
E2EM2	6	BC	6	BCD					
E2US2	7	BC	9	BCD					
E2RF2	8	BC	7	BCD					
E2US4	9	BC	12	BCD					
E2AB1	10	BC	8	BCD					
E2US1	11	BC	10	BCD					
L2US4	12	BC	11	BCD	0				
PAB3	13	BC	14	CD					
E1UB3	14	BC	15	CD	0				
E1AB3	15	BC	13	CD	0				
L2UB3	16	BC	26	D	-				
E2EM1	17	BC	16	CD	-				
PEM2	18	BC	17	D					
PEM1	19	BC	18	D	-				
PSS1	20	C	21	D					
R2UB3	21	C	20	D					
PAB1	22	C	19	D					
PUS4	23	C	22	D					
PUS5	24	C	23	D					
PUS3	25	C	24	D					
PUB3	26	C	25	D					
E2RS2	27	C	29	D					
E1AB1	28	C	28	D					
E1UB4	29	C	27	D					
Y. Common snipes						726	110	25	9/92, 11/91-92, 1/92-93, 3/92-93
PSS5	1	A	1	A					
L2RB2	2	AB	2	AB					
E2SS1	3	AB	3	ABC					
L2AB4	4	AB	4	ABC					
E2AB3	5	AB	6	BC	0				
E2EM2	6	AB							
E1UB4	7	AB							
E2US4	8	AB	7	BC					
L2UB1	9	AB							
E2SB3	10	B	5	BC					
E2EM1	11	B	8	C	0				
E2US3	12	B			0				
PAB3	13	B	10	C					

Dowitchers:

Density ranks varied ($F = 14.26$; 28, 5,523 df; MSE = 225,127; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 15.35$; 28, 5,518 df; MSE = 193,426; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 149.50$; 9 df; $P < 0.001$) among wetland types for this species.

Common snipes:

Density ranks varied ($F = 3.87$; 24, 5,069 df; MSE = 135,279; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 4.82$; 17, 4,436 df; MSE = 51,050; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 64.53$; 6 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
Y. Common snipes continued									
PAB1	14	B	11	C					
PEM1	15	B	14	C	0				
PEM2	16	B	13	C					
L2US4	17	B							
PUS3	18	B	9	C					
PSS1	19	B	16	C					
PUB3	20	B	12	C	+				
PAB4	21	B							
PUS5	22	B	15	C					
E1UB3	23	B	18	C	-				
R2UB3	24	B							
PUS4	25	B	17	C					
Z. Western sandpipers						18,602	161	34	9/91-92, 11/91-92, 1/92-93, 3/92-93
L2US3	1		1	A					
L2RB2	2		2	AB					
E1RB1	3								
E2US4	4		3	AB	0				
E1UB1	5		5	AB					
PSS4	6		4	AB					
PSS5	7		9	AB					
E2AB1	8		6	AB	0				
E2RS2	9		8	AB					
E1UB4	10		7	AB					
E2AB3	11		10	AB	0				
E2US3	12		11	AB	+				
E2US2	13		12	AB					
E2EM2	14		13	AB					
E2US1	15		15	AB					
E1UB2	16		14	AB					
E1UB3	17		16	AB	0				
E2SB3	18		17	AB					
E2EM1	19		19	AB	0				
L1UB3	20		18	AB	0				
L2UB3	21		20	AB	-				
E1AB3	22		21	AB	-				
PAB1	23		22	AB					
L2US4	24		23	AB					
PAB3	25		24	AB					
PUS3	26		25	B					
R2UB3	27		26	B					
PUB4	28		27	B					
PEM2	29		28	B					
PUB3	30		29	B					
PEM1	31		30	B	-				
R4SB5	32		31	B					
PSS1	33								
PUS4	34		32	B					

Density ranks varied ($F = 14.53$; 33, 5,745 df; MSE = 209,994; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 14.67$; 31, 5,518 df; MSE = 191,848; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 121.84$; 10 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
AA. Least sandpipers						10,195	84	20	9/91-92, 11/91-92, 1/92-93, 3/92-93
E1UB4	1		4						
E2RS2	2		1						
L2RB2	3		2						
E2AB3	4		3		-				
E2US4	5		5						
E2US3	6		6		+				
E2US2	7		7						
E2AB1	8		8						
L2AB4	9		9						
E1AB3	10		10						
L2UB3	11								
E2EM1	12		11		0				
L1UB3	13		12						
E1UB3	14		13		0				
PEM2	15		14						
PAB3	16		15						
PUB4	17		16						
PSS1	18		17						
PEM1	19		18		-				
PUB3	20		19						
BB. Laughing gulls						14,331	313	34	9/92, 11/92, 1/93, 3/93
E2RS2	1	A	6	AB					
E2US1	2	AB	13	AB					
E1UB1	3	ABC							
E1UB2	4	ABC	1	A					
E1AB3	5	ABC	2	AB	0				
E2US4	6	ABC	3	AB	0				
E2US3	7	ABC	7	AB	+				
E2AB1	8	ABC	10	AB	0				
L1UB3	9	ABC	5	AB	0				
E2AB3	10	ABC	12	AB	0				
E2US2	11	ABC	15	AB	0				
L2UB3	12	ABC	4	AB	0				
E1UB3	13	ABC	9	AB	+				
L2AB3	14	ABC	11	AB					
PSS4	15	ABC							
E2EM2	16	ABC	14	AB					
E1AB1	17	ABC	8	AB					
R1UB3	18	ABC	19	AB					
E1UB4	19	ABC	16	AB					
L2UB1	20	ABC			-				
E2EM1	21	ABC	18	AB	-				
L2AB4	22	ABC	17	AB	-				
PUB4	23	ABC	24	B					
PUS2	24	BC	20	AB					
PSS1	25	C	23	B					
PAB4	26	C							
PAB1	27	C	21	B					
PUB3	28	C	25	B					

Least sandpipers:

Density ranks varied ($F = 10.63$; 19, 3,839 df; MSE = 77,479; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 10.79$; 18, 3,783 df; MSE = 72,906; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 100.74$; 5 df; $P < 0.001$) among wetland types for this species.

Laughing gulls:

Density ranks varied ($F = 23.08$; 33, 4,432 df; MSE = 279,939; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 15.67$; 28, 4,139 df; MSE = 186,760; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 157.14$; 14 df; $P < 0.001$) among wetland types for this species.

Table 3. *Continued.*

Wetland type[b]	Density rank[c]	Density rank means separation[d]	Proportion feeding rank[e]	Proportion feeding rank means separation[d]	Wetland selection[f]	Number of birds	Number of flocks	Number of wetland types used	Dates
BB. Laughing gulls continued									
PEM1	29	C	22	B	-				
PEM2	30	C	26	B					
PAB3	31	C	27	B					
PUS3	32	C	28	B					
R2UB3	33	C			-				
PUS4	34	C	29	B					
CC. Ring-billed gulls						2,438	91	22	11/92, 1/93, 3/93
E1RF2	1	A	1	A					
E1AB3	2	AB	2	AB					
E2RS2	3	ABC							
E2US1	4	ABC							
L2UB3	5	ABC	3	ABC	0				
L1UB3	6	ABC	10	C					
E2RF2	7	ABC	4	ABC					
E2US3	8	ABC	7	BC	0				
E2US2	9	ABC	12	C	0				
E2US4	10	ABC	5	BC					
E2AB3	11	ABC	8	BC	0				
E1UB2	12	ABC	6	BC					
E2AB1	13	ABC	9	C					
R1UB3	14	ABC	11	C					
E1UB3	15	BC	13	C	0				
E2EM1	16	BC	14	C	-				
PAB3	17	BC	15	C					
PEM2	18	BC	16	C					
PUB3	19	BC	17	C	0				
PUS3	20	BC	18	C					
PEM1	21	BC	19	C	-				
PUS4	22	C	20	C	0				

Density ranks varied ($F = 16.60$; 21, 3,053 df; MSE = 61,385; $P < 0.001$) among wetland types for this species.

Proportion feeding ranks varied ($F = 15.85$; 19, 3,043 df; MSE = 45,299; $P < 0.001$) among wetland types for this species.

Wetland selection varied ($X^2 = 64.32$; 10 df; $P < 0.001$) among wetland types for this species.

[a]Only wetland types used by each specific species were analyzed.
[b]Wetland types follow Cowardin et al. (1979); see Table 1 for code definitions.
[c]Density ranks varied for each species among wetland types.
[d]Wetland types with the same letter had rank means that did not differ (Modified Scheffe's procedure; $P > 0.10$).
[e]Proportion feeding ranks varied for each species among wetland types. Only wetland types on which feeding birds were observed were ranked.
[f]Wetland selection varied for each species among wetland types following methods by Neu et al. (1974); 0 indicates no preference or avoidance, + indicates preference, and - indicates avoidance ($\alpha = 0.10$). Rows with no wetland selection symbols were combined because of inadequate sample sizes for the homogeneity Chi-square test.

floating vascular wetlands and palustrine scrub-shrub broad-leaved deciduous wetlands.

Pelicans, Anhingas, and Cormorants

American white pelicans used 27 wetland types that represented 91.6% of the available wetland habitat. Density and PFB ranks were highest in estuarine subtidal and lacustrine littoral wetlands, especially in unconsolidated bottom types (Table 3B).

Brown pelicans used 10 wetland types that represented 33.6% of the available wetland habitat. Density ($F = 3.13$; 9, 748 df; $P = 0.001$) and PFB ($F = 3.50$; 7, 729 df; $P = 0.001$) ranks were highest in estuarine wetlands. Density ranks were highest in estuarine intertidal unconsolidated shore cobble-gravel and in subtidal aquatic-bed rooted vascular

wetlands. Proportion of feeding bird ranks were especially high in estuarine subtidal aquatic-bed rooted vascular and estuarine subtidal aquatic-bed algal wetlands.

Anhingas (*Anhinga anhinga*) used 14 wetland types that represented 45.5% of the available wetland habitat. Density ($F = 5.35$; 13, 1,963 df; $P < 0.001$) and PFB ($F = 6.59$; 7, 1,490 df; $P < 0.001$) ranks were highest in wetlands with more than 30% aquatic-bed vegetation or with unconsolidated substrates. Density ranks were especially high in lacustrine littoral unconsolidated bottom sand and aquatic-bed floating vascular wetlands. Proportion of feeding bird ranks were highest in lacustrine littoral aquatic-bed rooted vascular and lacustrine littoral unconsolidated mud wetlands. Density and PFB ranks were also high in palustrine aquatic-bed floating vascular wetlands.

Neotropic cormorants (*Phalacrocorax brasilianus*) used 20 wetland types that represented 86.5% of the available area of wetland habitat in the study area. Density ($F = 5.69$; 19, 2,901 df; $P < 0.001$) and PFB ($F = 3.65$; 10, 1,459 df; $P < 0.001$) ranks were highest in lacustrine limnetic rock bottom rubble wetlands. Density ranks were also high in lacustrine limnetic unconsolidated bottom mud, lacustrine littoral unconsolidated bottom mud, and riverine tidal unconsolidated bottom mud wetlands. Proportion of feeding bird ranks were also high in estuarine subtidal aquatic-bed algal, lacustrine littoral aquatic-bed floating vascular, and lacustrine littoral unconsolidated bottom mud wetlands.

Double-crested cormorants used 31 wetland types that represented 91.6% of the available wetland habitat. Density and PFB ranks were highest in lacustrine wetlands, especially lacustrine littoral unconsolidated bottom cobble-gravel and lacustrine limnetic unconsolidated bottom mud wetlands (Table 3C).

Herons, Egrets, and Allies

Least bitterns (*Ixobrychus exilis*) used four wetland types that represented 51.2% of the available wetland habitat (estuarine intertidal emergent persistent, estuarine intertidal aquatic-bed rooted vascular, palustrine scrub-shrub broad-leaved deciduous, and palustrine emergent persistent wetlands). No differences in density and PFB ranks were observed.

American bitterns (*Botaurus lentiginosus*) used 10 wetland types that represented 62.2% of the available wetland habitat. Density ($F = 3.53$; 9, 2,294 df; $P < 0.001$) and PFB ($F = 13.06$; 3, 1,438 df; $P < 0.001$) ranks were highest in lacustrine littoral aquatic-bed floating vascular, estuarine intertidal unconsolidated shore organic, estuarine intertidal emergent persistent, palustrine emergent persistent, and palustrine emergent nonpersistent wetlands.

Black-crowned night-herons (*Nycticorax nycticorax*) used 25 wetland types that represented 84.7% of the available wetland habitat. Density and PFB ranks were highest in wetlands with more than 30% vegetation (Table 3D). Density ranks were especially high in estuarine intertidal scrub-shrub needle-leaved evergreen and palustrine scrub-shrub needle-leaved evergreen wetlands. Proportion of feeding bird ranks were especially high in riverine lower perennial aquatic-bed rooted vascular wetlands.

Yellow-crowned night-herons (*N. violaceus*) used 13 wetland types that represented 70.0% of the available wetland habitat. Density ($F = 4.47$; 12, 1,603 df; $P < 0.001$) and PFB ($F = 4.27$; 7, 960 df; $P < 0.001$) ranks were highest in estuarine intertidal unconsolidated shore organic, estuarine subtidal unconsolidated bottom mud, and palustrine forested broad-leaved deciduous wetlands.

Green herons (*Butorides virescens*) used 26 wetland types that represented 80.2% of the available wetland habitat. Density ($F = 6.41$; 25, 4,061 df; $P < 0.001$) ranks were highest in lacustrine littoral unconsolidated bottom sand, lacustrine littoral aquatic-bed floating vascular, and riverine lower perennial aquatic-bed floating vascular wetlands. Proportion of feeding bird ($F = 5.66$; 18, 3,013 df; $P < 0.001$) ranks were highest in lacustrine littoral aquatic-bed floating vascular, and palustrine aquatic-bed floating vascular and palustrine forested broad-leaved deciduous wetlands.

Tricolored herons (*Egretta tricolor*) used 32 wetland types that represented 92.1% of the available wetland habitat. Density ranks were highest in lacustrine littoral, estuarine intertidal, and palustrine wetlands (Table 3E). Proportion of feeding bird ranks were highest in certain types of estuarine intertidal wetlands. They selectively used estuarine intertidal emergent persistent wetlands.

Little blue herons (*E. caerulea*) used 29 wetland types that represented 88.3% of the available wetland habitat. Density and PFB ranks were highest in estuarine and lacustrine wetlands with more than 30%

vegetation, especially lacustrine littoral emergent nonpersistent wetlands (Table 3F).

Reddish egrets (*E. rufescens*) used 14 wetland types that represented 51.3% of the available wetland habitat. Density ($F = 5.18$; 13, 1,516 df; $P < 0.001$) and PFB ($F = 4.34$; 13, 1,514 df; $P < 0.001$) ranks were highest in estuarine subtidal unconsolidated bottom cobble-gravel, estuarine intertidal emergent nonpersistent, and estuarine intertidal aquatic-bed rooted vascular and estuarine intertidal aquatic-bed algal wetlands.

Cattle egrets used 21 wetland types that represented 72.1% of the wetland habitat. Density and PFB ranks were highest in unconsolidated substrate or aquatic-bed wetlands, especially lacustrine littoral aquatic-bed floating vascular or lacustrine littoral aquatic-bed rooted vascular wetlands (Table 3G).

Snowy egrets used 52 wetland types that represented 97.7% of the available wetland habitat. Density and PFB ranks were highest in estuarine intertidal and lacustrine littoral wetlands, especially lacustrine littoral emergent nonpersistent wetlands (Table 3H). They selectively used two types of palustrine wetlands.

Great egrets used 49 wetland types that represented 97.6% of the available wetland habitat. Density and PFB ranks were highest in lacustrine and estuarine wetlands, especially lacustrine wetlands with more than 30% vegetation or with rock bottom substrates (Table 3I).

Great blue herons used 45 wetland types that represented 97.4% of the available wetland habitat. Density ranks were highest in estuarine and lacustrine wetlands with less than 30% vegetation (Table 3J). Proportion of feeding bird ranks were highest in estuarine intertidal and lacustrine littoral wetlands with organic substrates or more than 30% vegetation. They selectively used 11 wetland types with vastly different characteristics.

Wood storks used four wetland types that represented 40.1% of the available wetland habitat. Density ($F = 7.58$; 3, 384 df; $P < 0.001$) and PFB ($F = 11.16$; 3, 382 df; $P < 0.001$) ranks were highest in estuarine subtidal unconsolidated bottom organic, palustrine unconsolidated shore mud, and palustrine emergent persistent wetlands.

White-faced ibises used 18 wetland types that represented 75.2% of the available wetland habitat. Density and PFB ranks were highest in aquatic-bed wetlands, especially lacustrine littoral aquatic-bed rooted vascular and lacustrine littoral aquatic-bed floating vascular wetlands (Table 3K). They selectively used certain types of palustrine wetlands with more than 30% vegetation.

White ibises used 26 wetland types that represented 87.6% of the available wetland habitat. Density and PFB ranks were highest in wetlands with less than 30% emergent vegetation, especially lacustrine littoral unconsolidated substrate types (Table 3L). They selectively used estuarine intertidal emergent persistent and palustrine aquatic-bed rooted vascular wetlands.

Roseate spoonbills (*Ajaia ajaja*) used 16 wetland types that represented 77.9% of the available wetland habitat. Density and PFB ranks were highest in estuarine wetlands with unconsolidated substrates, especially estuarine subtidal unconsolidated bottom organic wetlands (Table 3M).

Whooping Cranes

Whooping cranes used three wetland types that represented 14.7% of the available wetland habitat (estuarine intertidal unconsolidated shore mud, palustrine emergent persistent, and estuarine intertidal emergent persistent wetlands). Density and PFB ranks did not differ among wetland types.

Rails, Moorhens, Gallinules, and Coots

King rails (*Rallus elegans*) used six wetland types that represented 50.3% of the available wetland habitat (estuarine intertidal aquatic-bed rooted vascular, estuarine intertidal emergent persistent, palustrine emergent persistent, palustrine aquatic-bed rooted vascular, palustrine aquatic-bed floating vascular, and lacustrine limnetic unconsolidated bottom mud). Density and PFB ranks did not differ among wetland types.

Clapper rails (*R. longirostris*) used 10 wetland types that represented 72.8% of the available wetland habitat. Density ($F = 24.67$; 9, 2,321 df; $P < 0.001$) and PFB ($F = 8.13$; 7, 1,773 df; $P < 0.001$) ranks were highest in estuarine wetlands with more than 30% vegetation, especially estuarine intertidal emergent persistent, estuarine intertidal emergent nonpersistent, estuarine subtidal aquatic-bed rooted vascular, and estuarine intertidal aquatic-bed rooted vascular.

Virginia rails (*R. limicola*) used three wetland types that represented 49.7% of the available wetland habitat (estuarine intertidal unconsolidated shore mud, estuarine intertidal emergent persistent, palustrine emergent persistent). No differences in density ranks or PFB ranks among wetland types were observed.

Soras (*Porzana carolina*) used eight wetland types that represented 61.1% of the available wetland habitat. Density ($F = 1.90$; 7, 1,964 df; $P = 0.066$) ranks were highest in estuarine intertidal scrub-shrub broad-leaved deciduous, riverine tidal unconsolidated bottom mud, and estuarine intertidal emergent persistent wetlands. Proportion of feeding bird ranks did not differ among wetland types (palustrine scrub-shrub broad-leaved deciduous, palustrine emergent persistent, and estuarine intertidal emergent persistent).

Purple gallinules (*Porphyrula martinica*) used six wetland types that represented 46.6% of the available wetland habitat. Density ($F = 3.39$; 5, 798 df; $P = 0.005$) ranks were highest in lacustrine littoral aquatic-bed floating vascular, lacustrine littoral unconsolidated bottom mud, and palustrine aquatic-bed algal wetlands. Proportion of feeding bird ($F = 22.81$; 1, 416 df; $P < 0.001$) ranks were highest in lacustrine littoral aquatic-bed floating vascular and palustrine emergent persistent wetlands.

Common moorhens (*Gallinula chloropus*) used 23 wetland types that represented 81.9% of the available wetland habitat. Density and PFB ranks were highest in certain types of wetlands with more than 30% vegetation, especially aquatic-bed rooted vascular or floating vascular wetlands (Table 3N). The birds selectively used palustrine aquatic-bed rooted vascular and palustrine emergent persistent wetlands.

American coots used 29 wetland types that represented 92.4% of the available wetland habitat. Density and PFB ranks were highest in lacustrine littoral wetlands, especially lacustrine littoral aquatic-bed rooted vascular or lacustrine littoral aquatic-bed floating vascular wetlands (Table 3O). They selectively used lacustrine littoral aquatic-bed rooted vascular and palustrine unconsolidated bottom mud wetlands.

Shorebirds

American oystercatcher (*Haematopus palliatus*) used nine wetland types that represented 28.6% of the available wetland habitat. Density ($F = 3.27$; 8, 663 df; $P < 0.001$) and PFB ($F = 4.68$; 8, 663 df; $P < 0.001$) ranks were highest in estuarine intertidal rocky shore rubble, estuarine intertidal unconsolidated shore cobble-gravel, and estuarine intertidal reef mollusk wetlands.

American avocets (*Recurvirostra americana*) used 20 wetland types that represented 74.5% of the available wetland habitat. Density ranks were highest in palustrine and estuarine wetlands, especially in estuarine subtidal unconsolidated bottom cobble-gravel and palustrine scrub-shrub needle-leaved evergreen wetlands (Table 3P). Proportion of feeding bird ranks were highest in estuarine wetlands, especially in estuarine subtidal unconsolidated bottom cobble-gravel and estuarine intertidal emergent nonpersistent. They selectively used estuarine intertidal unconsolidated shore mud wetlands.

Black-necked stilts (*Himantopus mexicanus*) used 27 wetland types that represented 90.9% of the available wetland habitat. Density and PFB ranks were highest in estuarine intertidal wetlands, especially in wetlands with mud substrates or rooted vascular vegetation (Table 3Q).

Snowy plovers (*Charadrius alexandrinus*) used eight wetland types that represented 66.0% of the available wetland habitat. Density ($F = 9.72$; 7, 1,073 df; $P < 0.001$) ranks were highest in estuarine intertidal unconsolidated shore cobble-gravel, estuarine intertidal unconsolidated shore sand, and estuarine intertidal unconsolidated shore organic wetlands. Proportion of feeding bird ($F = 7.34$; 6, 1,069 df; $P < 0.001$) ranks were highest in estuarine intertidal unconsolidated shore organic, estuarine intertidal unconsolidated shore sand, and estuarine intertidal aquatic-bed rooted vascular wetlands.

Piping plovers used eight wetland types that represented 33.0% of the available wetland habitat (estuarine intertidal emergent persistent, estuarine intertidal unconsolidated shore sand, estuarine intertidal unconsolidated shore mud, estuarine intertidal unconsolidated shore organic, estuarine intertidal aquatic-bed rooted vascular, estuarine intertidal aquatic-bed algal, estuarine subtidal aquatic-bed rooted vascular, and estuarine subtidal unconsolidated bottom mud). Density and PFB ranks did not differ among wetland types. Feeding was not observed on estuarine intertidal aquatic-bed algal and estuarine intertidal aquatic-bed rooted vascular wetlands.

Wilson's plovers (*C. wilsonia*) used 10 wetland types that represented 73.5% of the available wetland habitat. Density ($F = 6.37$; 9, 1,616 df; $P < 0.001$) and PFB ($F = 4.96$; 9, 1,616 df; $P < 0.001$) ranks were highest in estuarine subtidal unconsolidated bottom organic, estuarine intertidal unconsolidated shore sand, and estuarine intertidal unconsolidated shore organic wetlands.

Semipalmated plovers (*C. semipalmatus*) used 10 wetland types that represented 68.9% of the available wetland habitat. Density ($F = 24.70$; 9, 3,070 df; $P < 0.001$) and PFB ($F = 19.62$; 9, 3,070 df; $P < 0.001$) ranks were highest in estuarine intertidal unconsolidated shore sand, estuarine intertidal unconsolidated shore cobble-gravel, and estuarine intertidal unconsolidated shore organic wetlands.

Killdeer (*C. vociferus*) used 48 wetland types that represented 96.7% of the available wetland habitat. Density and PFB ranks were highest in lacustrine littoral and estuarine wetland types with unconsolidated substrates, especially in lacustrine littoral unconsolidated bottom sand and lacustrine littoral unconsolidated shore vegetated wetlands (Table 3R). The birds selectively used a variety of wetland types, including three palustrine and lacustrine types with unconsolidated substrates and palustrine emergent persistent wetlands.

Black-bellied plovers (*Pluvialis squatarola*) used 17 wetland types that represented 51.7% of the available wetland habitat. Density and PFB ranks were highest in estuarine wetlands, especially wetlands that were dominated by oysters (*Crassostrea* spp.), rubble shores, or organic substrates (Table 3S). They selectively used estuarine intertidal unconsolidated shore mud wetlands.

American golden plovers (*P. dominica*) used 11 wetland types that represented 86.5% of the available wetland habitat. Density ($F = 1.78$; 10, 2,463 df; $P = 0.059$) and PFB ($F = 2.87$; 6, 2,216 df; $P = 0.009$) ranks were highest in lacustrine littoral and estuarine intertidal unconsolidated shore organic wetlands.

Marbled godwits (*Limosa fedoa*) used eight wetland types that represented 51.4% of the available wetland habitat (estuarine subtidal aquatic-bed rooted vascular, estuarine subtidal unconsolidated bottom mud, estuarine intertidal unconsolidated shore organic, estuarine intertidal unconsolidated shore mud, estuarine subtidal rock bottom rubble, estuarine intertidal unconsolidated shore sand, estuarine subtidal aquatic-bed rooted vascular, and estuarine intertidal emergent persistent wetlands). Density and PFB ranks did not differ among wetland types.

Whimbrels (*Numenius phaeopus*) used eight wetland types that represented 44.7% of the available wetland habitat. Density ($F = 3.36$; 7, 1,316 df; $P = 0.002$) and PFB ($F = 3.30$; 5, 1,121 df; $P = 0.006$) ranks were highest in estuarine intertidal unconsolidated shore sand, estuarine subtidal aquatic-bed algal, estuarine subtidal unconsolidated bottom mud, and estuarine subtidal aquatic-bed rooted vascular wetlands.

Long-billed curlews (*N. americanus*) used 24 wetland types that represented 82.7% of the available wetland habitat. Density and PFB ranks were highest in estuarine wetlands with less than 30% persistent emergent vegetation, especially estuarine intertidal emergent nonpersistent wetlands (Table 3T).

Willets (*Catoptrophorus semipalmatus*) used 23 wetland types that represented 77.8% of the available wetland habitat. Density and PFB ranks were highest in estuarine wetlands with less than 30% vegetation (Table 3U). The birds selectively used estuarine intertidal aquatic-bed rooted vascular, estuarine intertidal unconsolidated shore sand, and estuarine intertidal unconsolidated shore mud wetlands.

Greater yellowlegs (*Tringa melanoleuca*) used 27 wetland types that represented 87.8% of the available wetland habitat. Density and PFB ranks were highest in estuarine wetlands, especially estuarine intertidal unconsolidated shore organic wetlands (Table 3V). The birds selectively used estuarine intertidal aquatic-bed rooted vascular and unconsolidated shore mud wetlands.

Lesser yellowlegs (*Tringa flavipes*) used 28 wetland types that represented 84.9% of the available wetland habitat. Density and PFB ranks were highest in estuarine wetlands, especially estuarine intertidal unconsolidated shore organic wetlands (Table 3W). The birds selectively used estuarine intertidal unconsolidated shore mud wetlands.

Solitary sandpipers (*T. solitaria*) used 16 wetland types that represented 73.4% of the available wetland habitat. Density ($F = 3.21$; 15, 3,056 df; $P < 0.001$) and PFB ($F = 3.38$; 15, 3,055 df; $P < 0.001$) ranks were highest in estuarine intertidal reef mollusk, estuarine intertidal unconsolidated shore organic, and riverine intermittent streambed organic wetlands.

Spotted sandpipers (*Actitis macularia*) used 27 wetland types that represented 53.7% of the available

area of wetland habitat in the study area. Density ($F = 11.39$; 26, 2,891 df; $P < 0.001$) and PFB ($F = 10.75$; 26, 2,889 df; $P < 0.001$) ranks were highest in lacustrine littoral rock bottom rubble and unconsolidated shore mud wetlands.

Dowitchers used 29 wetland types that represented 95.6% of the available wetland habitat. Density and PFB ranks were highest in lacustrine and estuarine wetlands with less than 30% vegetation, especially estuarine subtidal unconsolidated bottom cobble-gravel wetlands (Table 3X). Dowitchers selectively used estuarine intertidal aquatic-bed rooted vascular wetlands.

Stilt sandpipers (*Calidris himantopus*) used seven wetland types that represented 62.3% of the available wetland habitat in the study area. Density ($F = 2.29$; 6, 1,941 df; $P = 0.033$) and PFB ($F = 2.84$; 6, 1,941 df; $P = 0.009$) ranks were highest in estuarine intertidal unconsolidated shore organic, estuarine intertidal unconsolidated shore sand, estuarine intertidal aquatic-bed rooted vascular, and palustrine emergent nonpersistent wetlands.

Common snipe (*Gallinago gallinago*) used 25 wetland types that represented 78.4% of the available wetland habitat. Density and PFB ranks were highest in several different wetland types including scrub-shrub, rubble, and aquatic-bed floating vascular types (Table 3Y). The birds selectively used palustrine unconsolidated bottom mud wetlands.

Ruddy turnstones (*Arenaria interpres*) used 10 wetland types that represented 47.0% of the available wetland habitat. Density ($F = 35.34$; 9, 1,142 df; $P < 0.001$) and PFB (F = 41.73; 9, 1,142 df; $P < 0.001$) ranks were highest in estuarine intertidal rocky shore rubble, estuarine intertidal unconsolidated shore cobble-gravel, estuarine intertidal reef mollusk, estuarine intertidal emergent nonpersistent, and estuarine intertidal aquatic-bed algal wetlands.

Red knots (*Calidris canutus*) used 10 wetland types that represented 47.3% of the available wetland habitat. Density ($F = 2.04$; 9, 1,485 df; $P = 0.032$) ranks were highest in lacustrine littoral aquatic-bed rooted vascular, estuarine intertidal emergent nonpersistent, and estuarine intertidal unconsolidated shore organic wetlands. Proportion of feeding bird ($F = 1.77$; 7, 1,275 df; $P = 0.090$) ranks were highest in estuarine intertidal emergent nonpersistent, estuarine intertidal unconsolidated shore organic, and estuarine intertidal unconsolidated shore mud wetlands.

Dunlins (*C. alpina*) used nine wetland types that represented 45.8% of the available wetland habitat. Density ($F = 3.75$; 8, 943 df; $P < 0.001$) ranks were highest in estuarine intertidal reef mollusk, estuarine intertidal aquatic-bed rooted vascular, and estuarine intertidal unconsolidated shore mud wetlands. Proportion of feeding bird ($F = 3.04$; 8, 942 df; $P = 0.002$) ranks were highest in estuarine intertidal aquatic-bed rooted vascular, estuarine intertidal unconsolidated shore sand, and estuarine intertidal unconsolidated shore mud wetlands.

Sanderlings (*C. alba*) used 12 wetland types that represented 71.1% of the available wetland habitat. Density ($F = 14.90$; 11, 2,797 df; $P < 0.001$) and PFB ($F = 16.94$; 11, 2,795 df; $P < 0.001$) ranks were highest in estuarine intertidal reef mollusk, estuarine intertidal unconsolidated shore cobble-gravel, estuarine intertidal rocky shore rubble, and estuarine intertidal unconsolidated shore sand wetlands.

Semipalmated sandpipers (*C. pusilla*) used seven wetland types that represented 33.0% of the available wetland habitat (estuarine intertidal unconsolidated shore mud, estuarine intertidal unconsolidated shore sand, estuarine intertidal aquatic-bed rooted vascular, estuarine intertidal emergent persistent, estuarine subtidal aquatic-bed rooted vascular, estuarine subtidal unconsolidated bottom mud, and lacustrine littoral unconsolidated shore organic wetlands). Density and PFB ranks did not differ among wetland types.

Western sandpipers (*C. mauri*) used 34 wetland types that represented 91.3% of the available wetland habitat. Density and PFB ranks were highest in wetlands with less than 30% above-water vegetation, especially lacustrine littoral wetlands with less than 30% vegetation (Table 3Z). The birds selectively used estuarine intertidal unconsolidated shore mud wetlands.

Least sandpipers (*C. minutilla*) used 20 wetland types that represented 80.7% of the available wetland habitat. Density and PFB ranks were highest in wetlands with less than 30% vegetation, especially estuarine subtidal unconsolidated bottom organic and estuarine intertidal rocky shore rubble wetlands (Table 3AA). They selectively used estuarine intertidal unconsolidated shore mud wetlands.

White-rumped sandpipers (*C. fuscicollis*) used seven wetland types that represented 68.9% of the available area of wetland habitat in the study area. Density ($F = 5.50$; 6, 2,062 df; $P < 0.001$) and PFB ($F = 6.20$; 6, 2,061 df; $P < 0.001$) ranks were highest

in estuarine intertidal aquatic-bed rooted vascular, estuarine subtidal aquatic-bed rooted vascular, estuarine intertidal unconsolidated shore mud, and palustrine unconsolidated bottom organic wetlands.

Upland sandpipers (*Bartramia longicauda*) used four wetland types that represented 29.4% of the available wetland habitat (riverine intermittent streambed mud, palustrine emergent nonpersistent, estuarine intertidal emergent persistent, and palustrine unconsolidated shore organic). There was no difference between density ranks and PFB ranks among wetland types.

Gulls, Terns, and Allies

Franklin's gulls (*Larus pipixcan*) used three wetland types that represented 15.1% of the available wetland habitat (estuarine intertidal aquatic-bed algal, estuarine intertidal unconsolidated shore sand, and estuarine subtidal unconsolidated bottom mud wetlands). Density ranks did not differ among wetland types, but PFB ($F = 7.48$; 2, 352 df; $P < 0.001$) ranks differed. Proportion of feeding bird ranks were highest in estuarine intertidal aquatic-bed algal and estuarine intertidal unconsolidated shore sand wetlands.

Laughing gulls (*L. atricilla*) used 34 wetland types that represented 95.3% of the available wetland habitat. Density and PFB ranks were highest in estuarine wetlands, especially in estuarine intertidal rocky shore rubble and estuarine subtidal unconsolidated bottom sand wetlands (Table 3BB). The birds selectively used estuarine intertidal and subtidal wetlands with mud substrates.

Bonaparte's gulls (*L. philadelphia*) used four wetland types that represented 25.4% of the available wetland habitat. Density ($F = 6.32$; 3, 438 df; $P < 0.001$) and PFB ($F = 6.35$; 3, 438 df; $P < 0.001$) ranks were highest in lacustrine littoral aquatic-bed rooted vascular, lacustrine littoral unconsolidated bottom mud, and estuarine intertidal unconsolidated shore sand wetlands.

Ring-billed gulls (*L. delawarensis*) used 22 wetland types that represented 86.6% of the available wetland habitat. Density and PFB ranks were highest in estuarine and lacustrine wetlands with less than 30% above-water vegetation, especially in estuarine subtidal reef mollusk wetlands (Table 3CC).

Herring gulls (*L. argentatus*) used 17 wetland types that represented 79.4% of the available wetland habitat. Density ($F = 8.18$; 16, 1,600 df; $P < 0.001$) ranks were highest in lacustrine littoral unconsolidated bottom sand, estuarine subtidal aquatic-bed algal, and estuarine subtidal aquatic-bed rooted vascular wetlands. Proportion of feeding bird ($F = 7.96$; 13, 1,544 df; $P < 0.001$) ranks were highest in estuarine subtidal aquatic-bed algal, estuarine subtidal unconsolidated bottom organic, and estuarine intertidal unconsolidated shore cobble-gravel wetlands.

Common terns (*Sterna hirundo*) used 15 wetland types that represented 80.7% of the available wetland habitat. Density ($F = 5.06$; 14, 1,855 df; $P < 0.001$) and PFB ($F = 5.55$; 7, 620 df; $P < 0.001$) and ranks were highest in estuarine intertidal rocky shore rubble, subtidal aquatic-bed algal, and estuarine subtidal unconsolidated bottom sand wetlands.

Forster's terns (*S. forsteri*) used 17 wetland types that represented 88.4% of the available wetland habitat. Density ($F = 5.18$; 16, 1,704 df; $P < 0.001$) and PFB ($F = 4.48$; 16, 1,704 df; $P < 0.001$) ranks were highest in lacustrine limnetic rock bottom rubble, estuarine subtidal unconsolidated bottom organic, and estuarine intertidal aquatic-bed algal wetlands.

Gull-billed terns (*S. nilotica*) used 11 wetland types that represented 57.7% of the available wetland habitat. Density ($F = 5.34$; 10, 1,622 df; $P < 0.001$) and PFB ($F = 2.43$; 7, 1,507 df; $P = 0.018$) ranks were highest in lacustrine limnetic rock bottom rubble wetlands. Density ranks were also high in estuarine intertidal unconsolidated bottom organic and estuarine intertidal aquatic-bed algal wetlands. Proportion of feeding bird ranks were also high in estuarine intertidal aquatic-bed algal and lacustrine limnetic unconsolidated bottom mud wetlands.

Least terns (*S. antillarum*) used 19 wetland types that represented 85.4% of the available wetland habitat. Density ($F = 3.76$; 18, 2,250 df; $P < 0.001$) ranks were highest in estuarine intertidal unconsolidated shore cobble-gravel and subtidal unconsolidated bottom sand wetlands. Proportion of feeding bird ($F = 3.66$; 18, 2,250 df; $P < 0.001$) ranks were highest in estuarine subtidal aquatic-bed algal and unconsolidated bottom sand wetlands.

Sandwich terns (*S. sandvicensis*) used six wetland types that represented 39.3% of the available wetland habitat. Density ($F = 2.02$; 5, 964 df; $P = 0.007$) ranks were highest in estuarine subtidal unconsolidated bottom organic, estuarine intertidal aquatic-bed algal, and estuarine intertidal unconsolidated shore sand wetlands. Proportion of feeding

bird ranks did not differ (estuarine intertidal aquatic-bed algal and estuarine intertidal unconsolidated shore mud wetlands).

Royal terns (*S. maxima*) used nine wetland types that represented 55.2% of the available wetland habitat. Density ($F = 1.88$; 8, 880 df; $P = 0.0059$) ranks were highest in estuarine intertidal unconsolidated shore cobble-gravel, estuarine intertidal aquatic-bed rooted vascular, and lacustrine limnetic unconsolidated bottom mud wetlands. Proportion of feeding bird ranks did not differ among wetland types (estuarine intertidal aquatic-bed rooted vascular, estuarine intertidal unconsolidated shore mud, estuarine subtidal unconsolidated bottom mud, and lacustrine littoral unconsolidated bottom mud wetlands).

Caspian terns (*S. caspia*) used 19 wetland types that represented 87.6% of the available wetland habitat. Density ($F = 4.65$; 18, 2,446 df; $P < 0.001$) and PFB ($F = 6.59$; 11, 1,949 df; $P < 0.001$) ranks were highest in palustrine scrub-shrub needle-leaved evergreen, lacustrine littoral aquatic-bed rooted vascular, and lacustrine littoral aquatic-bed floating vascular wetlands.

Black skimmers (*Rynchops niger*) used eight wetland types that represented 54.7% of the available wetland habitat. Density ($F = 2.84$; 7, 938 df; $P = 0.006$) ranks were highest in estuarine wetlands with unconsolidated substrates or with more than 30% aquatic-bed vegetation, especially estuarine intertidal unconsolidated shore organic and estuarine intertidal aquatic-bed rooted vascular wetlands. Proportion of feeding bird ranks did not differ among wetland types.

Discussion

Grebes

Least and pied-billed grebes predominantly used wetlands that were dominated by rooted or floating vascular plant species. Eared grebes occurred primarily in wetlands without vegetation. These wetland types were moderately abundant, especially in the midcoast area (Muehl 1994). Grebes primarily feed on aquatic insects, crustaceans, amphibians, and fishes (Martin et al. 1951:48; Bent 1963a). Aquatic-bed wetlands can harbor frogs (Dickerson 1969), and the aquatic-bed and unconsolidated bottom wetlands provide habitat for fishes, crustaceans, and aquatic insects. Pied-billed grebes nest in aquatic-bed wetlands (Chabreck 1963).

Pelicans, Anhingas, and Cormorants

Use of estuarine and lacustrine wetlands with more than 30% submerged vegetation or with unconsolidated substrates by American white pelicans and brown pelicans probably resulted from their association with easily accessible fish populations (Carl 1940; Nixon and Oviatt 1973; Schiemer and Prosser 1976) or because there are greater fish capture rates (Brown 1983) in these habitats. These wetland types were moderately abundant and were distributed along the coast in both areas (Muehl et al. 1994).

Double-crested cormorants that winter in Texas feed primarily on nonsport and forage fish species (Campo et al. 1993). Freshwater fishes are relatively abundant in large, deep, and stable water bodies (lacustrine wetlands). Aquatic-bed vegetation provides a substrate that is attractive to invertebrates (Bourn and Cottam 1939). Fishes are attracted by these invertebrates and by the cover afforded by vegetation (Carl 1940; Howard-Williams and Liptrot 1980; Skinner and Smart 1984). Open-water areas near shore may provide suitable cover for fishes and allow cormorants unobstructed access and good visibility when they pursue prey fishes (Morrison et al. 1978).

Herons, Egrets, and Allies

Use of lacustrine littoral unconsolidated bottom sand wetlands by nonfeeding green and tricolored herons is probably attributable to the use by these birds of shallow-water roost areas. Green herons feed mainly on fishes and insects (Hancock and Kushlan 1984) and frequently were seen feeding while perched on top of floating vegetation. The use of floating vegetation wetlands by green herons may be related to the use by these birds of elevated perches for hunting (Kushlan 1976; Gibbs et al. 1991).

American bitterns may have actually been more abundant in emergent wetlands than in floating vascular wetlands but were missed in our surveys. Nonpersistent and floating vascular vegetation can be attractive to amphibians, crayfishes, and fishes and provide feeding opportunities for herons (M. W. Collopy and H. L. Jelks, Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program,

unpublished manuscript); added feeding opportunity may explain the high use of these vegetated wetland types by great egrets, great blue herons, little blue herons, American bitterns, cattle egrets, and green herons. Reid (1989) found that the highest densities of herons generally occur in areas with the highest prey densities.

High prey abundance in vegetated wetlands may also account for the high use of these wetland types by white-faced and white ibises. These two species also feed on fishes, aquatic insects, and crayfishes (Allen 1942; Martin et al. 1951), which may be attracted to vegetated wetlands. These wetland types occurred throughout the midcoast area (Muehl 1994). In Venezuela, white ibises generally feed in deep open-water habitats (Frederick and Bildstein 1992), which corresponds to the unconsolidated substrate types used in this study. These wetland types were rare and occurred primarily in the midcoast area (Muehl 1994).

Roseate spoonbills heavily used shallow flooded estuarine subtidal and palustrine scrub-shrub wetlands, which occurred primarily in the midcoast area (Muehl 1994). Roseate spoonbills depend on aquatic insects, fishes, and crustaceans for food (Allen 1942; Howard and Lowe 1984). Ecologically healthy subtidal and intertidal estuaries are known for their abundant fish and invertebrate populations (Cornelius 1984; Britton and Morton 1989). French tamarisk (*Tamarix gallica*) wetlands are important for some waterfowl species (e.g., the blue-winged teal [*Anas discors*]); the importance has been attributed to the ability of the French tamarisk to provide overhead cover and a substrate for invertebrate growth (Anderson 1994). This may also be the reason for the use of this habitat by roseate spoonbills. Additionally, fishes may be abundant in these areas because of high invertebrate densities and abundant cover.

Rails, Moorhens, Gallinules, and Coots

Because they probably provided abundant food, lacustrine littoral aquatic-bed rooted vascular and floating vascular wetlands were most important to American coots and common moorhens (Jones 1940; Meanly 1962, 1992; Dickerson 1969). These wetlands were moderately abundant throughout the midcoast area (Muehl 1994).

American coots feed on plant foods including pondweeds (*Potomogeton* spp.), water-milfoils (*Myriophyllum* spp.), and duckweeds (*Lemna* spp.) (Jones 1940). White and James (1978) found that American coots in southern Texas use portions of wetlands that were analogous to rooted or floating vascular wetlands. Common moorhens reportedly use wetlands dominated by water hyacinth and other aquatic-bed vegetation (Helm et al. 1987). Breeding purple gallinules generally select wetlands with large amounts of rooted or floating vascular vegetation (Helm 1982; Mulholland and Percival 1982; Helm et al. 1987).

Aquatic-bed wetlands were important to feeding king rails and purple gallinules. Aquatic insects, fishes, and frogs are important as food for king rails (Meanley 1962, 1992); use of aquatic-bed wetlands may be related to high densities of prey species. Emergent wetlands provide animal life (crayfishes, aquatic insects, and amphibians) and seeds (including cultivated rice) that rails consume (Meanley 1985). Clapper rails depend on coastal salt marsh that is dominated by cordgrass and other emergents (Sharp 1976; Hon et al. 1977). Mudflat areas adjacent to emergent wetlands are important foraging habitat (Clark and Lewis 1983).

Shorebirds

The use by American oystercatchers of estuarine wetlands dominated by rocky or unconsolidated substrates or dominated by oysters may be related to birds feeding on oysters (Britton and Morton 1989). Rocky shore wetlands and unconsolidated substrate wetlands, although not dominated by oysters, can provide areas conducive to oyster colonization or provide other animal life that oystercatchers consume (Ehrlich et al. 1988). Reef and rocky shore wetlands were relatively uncommon; unconsolidated substrate wetlands were more common (Muehl 1994).

Black-necked stilts and American avocets depend on invertebrates (Martin et al. 1951; Bent 1962a; Evans and Harris 1994). Vegetated wetland types and their associated plant communities generally provide suitable habitat for invertebrates (Gerstenberg 1979; Anderson 1994) and therefore attract stilts and avocets. American avocets forage in salt marsh habitat in California (Gerstenberg 1979), which we observed, especially in nonpersistent vegetated wetlands. The numbers of feeding birds in estuarine wetlands are generally lower during high tides (Evans and Harris 1994) or during extended low

tide periods when the soil dries (Gerstenberg 1979; Withers and Chapman 1993). Use of palustrine wetlands by shorebirds may be related to changes in the amount of available habitat types (Colwell 1993) or to stable and consistent water conditions that provide stable feeding conditions.

Estuarine intertidal unconsolidated shore wetlands were important for black-bellied, semipalmated, snowy, piping, Wilson's, and American golden plovers, possibly because of shallow water and available food. Shallow water areas and exposed shoreline of lacustrine littoral wetlands were heavily used by killdeers and American golden plovers. These wetland types were generally common along the coast in both study areas (Muehl 1994; Muehl et al. 1994).

Plovers in general depend on estuarine unconsolidated shore wetlands (Bent 1962b; Baker and Baker 1973; Gerstenberg 1979; Nicholls and Baldassarre 1990). However, we found the highest density and PFB ranks of piping plovers in salt marsh habitat. Salt marsh is generally considered unsuitable habitat for piping plovers (Nicholls and Baldassarre 1990), but it does provide suitable habitat for black-bellied plovers (Gerstenberg 1979). Killdeers were generalists and used mostly wetland habitats that had shallow water or moist soil areas.

Frequent use of unconsolidated substrate wetlands by greater and lesser yellowlegs, solitary sandpipers, least sandpipers, red knots, dowitchers, and long-billed curlews may have been attributable to the association by these birds with organic soil. Because many other researchers did not have an analogous organic soil category, results of some studies are not comparable with results from our study. Organic soils are generally dominated by decomposing detritus that provides an additional structure for invertebrate colonization (Kaminski and Prince 1981). Microorganisms colonize detritus to obtain energy and nutrients (McKnight and Low 1969) and form an important food source for aquatic invertebrates, allowing them to achieve high and stable populations (Swanson et al. 1974; Berrie 1976; Swanson and Meyer 1977). High macroinvertebrate densities are important for maintaining high sandpiper densities (Helmers 1992).

Use of unconsolidated substrate wetlands by dowitchers, lesser yellowlegs, sanderlings, willets, and ruddy turnstones was probably attributable to the association by these birds with cobble-gravel. In California, Page et al. (1979) also found that sanderlings were common on sand and pebble wetlands, but dowitchers were virtually absent. Some species of invertebrates occur in high densities in cobble substrates (Colwell and Landrum 1993).

Lacustrine wetlands with mud substrates were used heavily by dowitchers, spotted sandpipers, and western sandpipers. These wetland types included impoundments and some shallowly flooded sheetwater areas in fields; agriculture fields are exploited by shorebirds in this region (Sykes and Hunter 1978; Helmers 1992). These areas must contain abundant foods for sandpipers. Shorebird abundance correlated with prey biomass in some wetlands (Zwarts 1988). Nonetheless, the extent of invertebrate production and the factors of their production in agriculture areas is not well known.

Wetlands with rock-type substrates were used heavily by spotted sandpipers, least sandpipers, common snipe, western sandpipers, willets, and ruddy turnstones. Gill and Jorgenson (1979) reported much use of intertidal rocky beaches in Alaska by turnstones but not by western sandpipers. Spotted sandpipers generally used edges of constructed lacustrine areas, many of which had cement basins. The use of constructed estuarine intertidal rocky shore rubble habitats by least sandpipers may be related to the abundant invertebrate fauna or algae (both important food items) that colonize these areas (Lewis 1964; Stephenson and Stephenson 1972; Britton and Morton 1989).

Frequent use of estuarine intertidal wetlands by long-billed curlews and red knots was probably attributable to the association by these birds with nonpersistent emergent vegetation. Page et al. (1979) also found that long-billed curlews occasionally feed in salt marsh habitat. Crustaceans and mollusks are food items of long-billed curlews (Stenzel et al. 1976) and can occur in abundance in this habitat (Britton and Morton 1989). Red knots feed on invertebrates and seeds (Johnsgard 1981), both of which are available in this habitat.

Use of aquatic-bed wetlands by red knots, Baird's sandpipers, white-rumped sandpipers, greater yellowlegs, and dunlins was attributable to the association by these birds with rooted vascular vegetation, which is valuable habitat for these and several other shorebird species (Sperry 1940; Bourn and Cottam 1950; Martin et al. 1951). Aquatic insects are abundant on submerged aquatic vegetation

(Bourn and Cottam 1939) and in detritus from decomposing aquatic-bed vegetation (Nixon and Oviatt 1973).

Frequent use of aquatic-bed wetlands by whimbrels and white-rumped sandpipers was probably attributable to their association with algae. Black turnstone (*Arenaria melanocephala*) abundance in California was thought to be influenced by algae (Page et al. 1979). Dowitchers, red knots, black-bellied plovers, and American oystercatchers selected algal-covered flats in New Jersey (Burger at al. 1977). These results show that some component of algal wetlands is important to shorebirds. Wetlands dominated by oysters were most important for solitary sandpipers, dunlins, and sanderlings, but they were also important to willets and ruddy turnstones.

Estuarine intertidal unconsolidated shore wetlands were probably the most important habitat type for sandpipers in this and other studies (Gill and Jorgenson 1979; Page et al. 1979). Shorebirds are thought to use different areas based on substrate, which may influence prey densities (Page et al. 1979; Myers et al. 1980; Quammen 1982; Goss-Custard 1984; Zwarts 1988), but prey density, size, or species, which may not be strictly influenced by substrate type, may also influence distribution (Baker and Baker 1973; Stenzel et al. 1976; Sutherland 1982; Smith and Connors 1993). This differential use of substrate may be true, although we found many species of sandpipers using almost all available substrate types, even though density varied. Tradition may also play an important role in the use of wetland areas by shorebirds (Smith and Stiles 1979; Helmers 1992). The dynamic nature of coastal Texas wetlands (Muehl et al. 1994) and the continued destruction of these wetland habitats (Dahl 1990) in conjunction with the role of tradition may partially obscure important wetland types for a species. Traditional use of a habitat may also place additional strains on maintaining stable shorebird populations (Helmers 1992).

Gulls, Terns, and Allies

Frequent use of wetlands dominated by aquatic-bed vegetation by Bonaparte's, ring-billed, Franklin's, and herring gulls, and common, gull-billed, sandwich, least, Forster's, and royal terns was attributable to the association by these birds with high fish densities (Carl 1940; Bent 1963b; Nixon and Oviatt 1973; Schiemer and Prosser 1976). The use by ring-billed gulls of wetlands dominated by oysters was attributable to the association by these birds with bottom-dwelling fishes that are abundant in oyster reefs (Britton and Morton 1989). Use of wetlands with less than 30% vegetation by Bonaparte's, laughing, Franklin's, and herring gulls was related to the diverse fish community associated with unconsolidated substrates in estuarine subtidal and intertidal areas. Oyster wetlands were rare, whereas most other types were moderately abundant, especially in the coastal strata of the midcoast area (Muehl et al. 1994).

Frequent use of unconsolidated substrate or rooted vascular wetlands by black skimmers was probably attributable to the need by these birds for large areas devoid of emergent vegetation to catch fishes that are their main prey items (Bent 1963b). The black skimmer's method of catching prey by flying with its mouth open and the lower bill immersed in water probably necessitates the use of large, open areas. Some of these wetland types were moderately abundant and occurred along the coast in both study areas (Muehl et al. 1994).

Management Implications

Valuable wetland types for individual species and groups of wintering and migrating waterbirds in coastal Texas are now better known. However, substantial work remains to be done on wetland selection during migratory periods. Management agencies must identify the species or groups they want to manage to effectively use this information. Managers should prioritize for protection, creation, or enhancement of an array of wetland types that will fulfill their management objectives.

To be successful, management of wintering waterbirds in coastal Texas must involve private landowners. Management agencies and private organizations must cooperate with landowners and develop innovative methods of creating, preserving, or restoring wetlands. Currently, programs for acquisition of long-term wetland easements are not in place in coastal Texas. Easements were proven valuable for protecting prairie potholes in North Dakota (Sidle and Harmon 1987) and would be of value in Texas. Easements can ensure long-term protection of valuable wetland types at less cost and difficulty than direct purchase.

We recommend that 26 wetland types be considered in any comprehensive management of wintering and migrating waterbirds in coastal Texas (Table 4). These wetland types are recommended based on five or more species with a ranking of one or two for either density or proportion of feeding bird or wetlands that were selectively used.

Five wetland types were used by more than 15 species and should be of primary importance for management. These include palustrine aquatic-bed rooted vascular, estuarine intertidal unconsolidated shore sand, estuarine intertidal unconsolidated shore mud, estuarine intertidal unconsolidated shore organic, and lacustrine littoral aquatic-bed floating vascular types. Seven wetland types were used by 10-13 species and should be of secondary importance. These wetland types vary but include several unconsolidated substrate, rocky shore, and aquatic-bed types. Eight wetland types were used by seven to nine species and should be of tertiary importance. These were mainly estuarine unconsolidated bottom and aquatic-bed and palustrine vegetated types. Six wetland types were used by five or six species and should receive a quaternary priority rating. These types were estuarine wetlands lacking vegetation. Thirteen of these 26 wetland types are in common with the 22 priority wetland types recommended for waterfowl in this region (Anderson 1994).

Wetland management should be concentrated in the middle stratum in the Laguna Madre area and in the rice prairie and coastal strata of the midcoast area. Complexes of various wetland types should be targeted for waterbird management to provide suitable habitat for a variety of waterbird species. Wetland development should be considered in the context of existing wetlands adjacent to development sites.

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Table 4. Twenty-six priority wetland types for management of wintering waterbirds in the coastal plains of Texas. Only wetland types that were ranked number one or two for either density or proportion of feeding birds (or that were selectively used) for at least five species or groups are included.

Management priority[a]	Wetland type	Waterfowl priority[b]
1	Palustrine	
	aquatic-bed rooted vascular	1
	Estuarine intertidal	
	unconsolidated shore mud	3
	unconsolidated shore organic	3
	unconsolidated shore sand	
	Lacustrine littoral	
	aquatic-bed floating vascular	2
2	aquatic-bed rooted vascular	2
	Estuarine subtidal unconsolidated	
	bottom cobble-gravel	2
	Palustrine	
	unconsolidated bottom mud	2
	Estuarine intertidal	
	rocky shore rubble	
	Estuarine subtidal	
	unconsolidated bottom organic	
	Lacustrine littoral	
	unconsolidated bottom sand	
	Estuarine intertidal unconsolidated	
	shore cobble-gravel	
3	Palustrine scrub-shrub	
	needle-leaved evergreen	3
	Palustrine emergent persistent	
	Estuarine subtidal	
	aquatic-bed rooted vascular	3
	Estuarine intertidal	
	aquatic-bed rooted vascular	3
	emergent nonpersistent	
	Estuarine subtidal	
	unconsolidated bottom mud	
	aquatic-bed algal	
	Lacustrine limnetic	
	unconsolidated bottom mud	
4	Estuarine subtidal	
	unconsolidated bottom sand	
	Lacustrine littoral	
	emergent nonpersistent	2
	Estuarine intertidal	
	reef mollusk	
	emergent persistent	
	Lacustrine limnetic	
	rock bottom rubble	2
	Estuarine intertidal	
	aquatic-bed algal	3

[a]Priority one wetland types were important to $\geq$15 species or groups; priority two wetland types were important for 10-14 species or groups; priority three wetland types were important for seven to nine species or groups; and priority four wetland types were important to five or six species or groups. Priority one wetland types should receive highest management priority, followed by priorities two, three, and four in order.

[b]Waterfowl priorities from Anderson (1994).

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Wetland use and selection by species of waterbirds (shorebirds, wading birds, gulls, terns, grebes, cormorants, and pelicans) between the Rio Grande and Galveston Bay in coastal Texas were studied during September and November of 1991-92 and during January and March of 1992-93. Based on a stratified (by dominant land use) random sample of 64.75-ha plots, 88 species of waterbirds using the wetlands were observed. Ranks of density and proportion of feeding birds indicated that cormorants and pelicans preferred wetlands with less than 30% vegetation. Gulls, terns, and skimmers preferred certain types of estuarine and lacustrine wetlands with less than 30% vegetation, especially estuarine subtidal rock bottom rubble types. Grebes and rails selectively used palustrine aquatic-bed rooted vascular and unconsolidated bottom mud wetland types. Herons, egrets, and bitterns preferred certain types of lacustrine and estuarine wetlands. Shorebirds used estuarine intertidal wetlands. Waterbird management should focus on 26 of the 82 wetland types that we prioritized in the coastal plains of Texas. Management should focus on protecting, enhancing, or restoring complexes of various wetland types, especially estuarine aquatic-bed and intertidal unconsolidated substrate types.

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